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NOTE.—References to Insects and Fungi are indexed under the headings "Insects" and "Fungi" only, to Weeds under the heading "Weeds" only, and to Diseases of Animals under "Diseases of Animals" only.

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To avoid confusion in reference the term "Ministry" is used throughout, with a very few necessary exceptions, although the word "Board" may appear in the text.

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THE JOURNAL
OF THE
MINISTRY OF AGRICULTURE

Vol. XXXII. No. 1.

APRIL, 1925.

NOTES FOR THE MONTH.

Agricultural Policy.

In reply to questions in the House of Commons on 2nd March by Mr. MacKenzie Livingstone and Colonel Burton, the Minister of Agriculture and Fisheries, Mr. Edward Wood, made the following statement:—

"In view of the refusal of both of the Labour Unions to take part in the proposed conference of agricultural interests, the Government have come to the conclusion that it is impossible to establish a conference on the lines originally suggested. It was proposed by the Government in the hope that, if an agreement between the different sections of the industry could be attained, this might prove the foundation of an agreement between political parties as to a permanent national policy. The refusal of the Labour Unions to participate in the conference has destroyed this hope.

I have carefully considered the possibility of providing representation of farm workers other than from the two unions to which invitations were issued, but apart from the fact that such action would be unlikely to contribute to that political agreement which it was the main purpose of the suggested conference to secure, I am informed that in such an event the Council of the National Farmers' Union would withdraw their representatives.

In these circumstances it will be the duty of the Government, on their own responsibility, to frame such proposals for the assistance of agriculture as are consistent with the necessity of protecting the industry from the danger of sharp reversals of national policy, and with this end in view the Government propose, in accordance with their declared purpose of arriving at the greatest possible measure of agreement, to seek the co-operation of, and invite considered suggestions from the representatives of the different sections of the industry."

In accordance with the intention announced in the last part of the above statement, the Minister on 6th March addressed

a letter to agricultural associations inviting them to forward considered suggestions, or, alternatively, he suggested that two or three representatives of the associaions should be appointed to discuss the question with him.

The associations to whom the invitation has been issued are: The Central Landowners' Association; the Land Union; the Land Agents' Society; the Surveyors' Institution; the Royal Agricultural Society; the Central Chamber of Agriculture; the Workers' Union; the National Union of Agricultural Workers: and the National Farmers' Union.

*   *   *   *   *   *

Young Farmers' Clubs.

THE Ministry has taken over the supervision of the Young Farmers' Club movement, and has appointed an Inspector, who, assisted by the Woman Inspector, will endeavour to organise and co-ordinate the activities of the clubs and to give such supplementary aid as may be sought by local bodies who desire to extend the movement. The Ministry's Divisional Inspectors will also lend their aid to facilitate the provision of lectures and the dissemination of information by local authorities and educational institutions.

Those who are concerned with the furtherance of agricultural education, and who may have opportunities of promoting the establishment of Young Farmers' Clubs in suitable localities, will find helpful suggestions and information in the Ministry's Leaflet No. 103 which has recently been published.

Out of a total of 31 clubs originally promoted, 22 clubs are in active operation (20 in England, 1 in Wales, 1 in Scotland): 6 clubs, temporarily inactive, are being revived. The remaining 3 clubs closed down two years ago, but an endeavour is being made to resuscitate them. The membership totals 332 boys and girls, between the ages of 10 and 18 years.

The following list shows the kind of stock held by clubs :—

Calves	10 clubs.	Mixed (Calves, Pigs, Poultry, Bees, Apple trees)	1 club.
Rabbits	6 ,,	,, (Rabbits and Poultry)	1 ,,
Poultry	5 ,,	Ducks	1 ,,
Pigs	2 ,,		
Bees	2 ,,		
Horticultural ...	3 ,,		

The clubs have been promoted as follows :—

By Dairy Companies and others	18 clubs.	By Controller of Horticulture	1 club.
,, Private individuals	3 ,,	,, Agricultural Gazette	1 ,,
,, Schoolmasters...	3 ,,	,, Schoolmistress ...	1 ,,
,, Poultry experts	2 ,,	,, Boy Scout Local Association	1 ,,

By Breed Society, 1 club.

Most of the clubs have been recently visited, and in every case the keenness and enthusiasm of the members has been very marked. It was felt that a special effort should be made to enlist the sympathy and co-operation of societies interested in educational matters and bring prominently before the public the importance of this movement. Accordingly, the Ministry invited representatives of the Board of Education, the Royal Agricultural Society of England, the National Farmers' Union, the National Federation of Women's Institutes, County Education Authorities, County Agricultural Organisers, the Canadian National Railways and the United Dairies, Limited, to a conference with officers of the Ministry on 27th February. Mr. Dale, Assistant Secretary to the Ministry, presided.

The main features of the proceedings were :—

A brief survey was given of the present position of clubs, with a statement as to the reasons for their success or otherwise. With the exception of one girl who lost her swarm of bees owing to weather conditions, the members of all existing clubs are in a sound financial position. The 14 members of the Sussex Baby Beef Club made a net profit of £240 for the year ending 31st August, 1924. A balance of £50 in Lloyds Bank stands to the credit of 7 members of the Buckland (Buckingham) Mixed Club.

The capital necessary to start a club varies with the stock to be held :—

Approximately	£40 for a mixed club.
"	£50—£100 for a Calf or Beef Club.
Up to	£20 for a Bee Club.
"	£20 for a Poultry Club.
"	£25 for a Pig Club.

The Ministry will not make grants or loans to start the clubs, but hopes that promoters will come forward and provide the capital required locally. Clubs ought to be self-supporting at the end of the first year. Hitherto no difficulty has arisen in regard to the question of capital. There will be a central policy directed from the Ministry for the guidance of the clubs, but of sufficient elasticity to meet local conditions. It will be the policy of the Ministry to invite the active co-operation of Local Education Authorities, and the Board of Education is in sympathy with the aims of the movement. The National Farmers' Union and the National Federation of Women's Institutes have both promised to assist. For the provision of technical advice and of occasional lectures it is hoped that the clubs may look to the County Agricultural Staffs and to the Provincial Colleges.

The hearty co-operation of the Boys' and Girls' Club Movement in the Dominions and the United States is assured, and International Cattle Judging Contests have been arranged.

Reference was made to the public-spirited work of companies such as the United Dairies and Milkal Limited, whose directors have done much to promote and foster the movement.

The work of the Ministry will be largely organisation, and interesting local people in the project.

Interest in the Young Farmers' Clubs is rapidly growing throughout the country, judging by the large number of inquiries addressed to the Ministry. No doubt club work will be a prominent feature of the educational system in every county, as it is likely to introduce boys and girls to new or improved agricultural methods at a receptive age and to awaken in them a readiness to test and adopt new ideas. In their time the young people will influence to some extent the outlook; and even the practice, of older people with whom they come into close contact. The movement is almost certain to lead more boys and girls to take advantage of the scheme of agricultural education provided by local authorities through organised courses of instruction or the courses established at Farm Institutes, and, indeed, there is some evidence to show that there have been such results already.

The experience of the United States of America, Canada and New Zealand is that this movement is instrumental in making better citizens, better homes, and in helping to promote and maintain rural life on a sound and economic basis.

* * * * * *

Disposal of Dairy Sewage.

WITH the growth of the factory system for the manufacture of cheese and other milk products in this country the disposal of dairy sewage presents a grave difficulty. In several instances in which the dairy effluent has been discharged into a river or stream there has been pollution, and local authorities have made application to the Ministry of Health for consent to the taking of legal proceedings under the Rivers Pollution Prevention Acts. Moreover, in some instances considerable damage has been caused to sewage disposal works by the discharge of excessive quantities of dairy effluent into the sewers of local authorities, and in other ways such effluent has given rise to a nuisance.

In Holland, where the country is very flat and the waterways are sluggish, the treatment of such waste waters is of vital importance, and in order to investigate the matter thoroughly, as well as to give the factories practical assistance in overcoming their difficulties in this direction, a Government Institute for the Purification of Waste Waters was established by a Royal Decree of 30th July, 1920.

The aim of this Institute is to conduct experimental work at the Institute and at factory installations with the object of preventing the pollution of water. In this way the Institute exercises a direct influence on the prevention of contamination of the waterways, and at the same time is kept fully informed of the difficulties encountered by individual factories.

A report of a deputation—consisting of representatives of the Ministries of Agriculture and Health and the National Association of Creamery Proprietors—which recently visited Holland for the purpose of investigating the methods adopted in that country for overcoming the dairy sewage problem, has been received by the Ministry and describes some of the systems. It shows that in making a comparison between the conditions in Holland as affecting the treatment of dairy wastes with those in this country, it would appear that theoretically the law against pollution is stronger in this country, but in actual practice the results of the administration of the law are much the same in both countries.

Local authorities in Holland generally require that whey, buttermilk or separated milk should not be discharged with the waste waters, and this requirement is generally met.

If whey could be as fully utilised in this country as it is in Holland, there would be no essential difference between the dairy refuse in this country and in Holland, and methods of purification which are applicable there would be applicable here. The discharge of whey along with the dairy effluent is undoubtedly the greatest source of trouble in this country, and if it could be avoided greater advantage could be taken of the natural purification effected by the more rapidly flowing streams of this country. At the present stage of the investigation into this problem, there does not appear to be any system which will deal efficiently for any reasonable period with undiluted whey or separated milk. The best means of dealing with such by-products is the natural one of feeding them to stock on the farm, but how far this can be arranged under the present factory system seems to be a question that has not been investigated up to the present.

The methods in use seen by the deputation are classed as follows: (1) dilution; (2) land treatment or irrigation; (3) lime precipitation followed by septic tanks and percolating filters; (4) activated sludge process.

Dilution was not generally found to be effective, even in the case of large canals, for although they are of large volume, they are almost stagnant and so do not afford sufficient dilution to be effective. Land treatment is only effective where a large area of suitable sandy soil is available. Percolating filters are effective if proper attention is given to their construction and management.

The activated sludge process was only being investigated on a laboratory scale at the date of the visit, and therefore could not be classed as one of the systems in actual practice. It is, however, understood that subsequent working scale experiments have been put into operation, and that they are very promising. It is to be hoped that the results of these experiments will be forthcoming at a later date.

It would appear that if any systematic investigation of this problem is to be undertaken in this country, it can only be done effectively by the establishment of an Institution on the lines of the Government Institute for the Purification of Waste Waters already established in Holland. This is a very vital question for the dairy and other industries in this country, and no effort should be spared in endeavouring to solve the problems which it presents.

* * * * * *

Report of the Committee on Foot-and-Mouth Disease.

THE Departmental Committee appointed by the Minister in February, 1924, and consisting of the Rt. Hon. E. G. Pretyman (Chairman), Sir W. Bromley-Davenport, K.C.B., and Messrs. A. Batchelor, H. German, and W. R. Smith, which inquired into the circumstances of the serious outbreak of foot-and-mouth disease which occurred during 1923 and 1924, has now issued its Report.*

The Report, which is signed by all the members, traces the causes which led to the extraordinary development of the disease, with special reference to the circumstances attaching to the introduction and spread of disease in Cheshire.

It contains a number of important conclusions and recommendations with regard to the policy of the Ministry in dealing with outbreaks of the disease; the manner in which that policy

* Cmd. 2350, to be obtained either direct from H.M. Stationery Office, price 1s. 6d., or through a bookseller.

has been carried out by the Ministry and Local Authorities; precautions against the introduction and spread of the disease; compensation for slaughter; restrictions on the movement of animals and persons; and insurance, both compulsory and voluntary.

The Report cannot fail to be of interest to all who are in any way connected with the administration of the Diseases of Animals Acts, whether as members or officials of Local Authorities, or as stock owners.

* * * * * *

Licensing of Stallions in Season 1925.

THE decline in horse breeding, as shown in the Agricultural Returns last June, when the number of stallions used for service was returned as 4,707 as compared with 5,459 in 1923, and the number of foals as 54,801 as compared with 66,323 in the previous year, is further emphasised by the records available to 21st March as to the number of stallions licensed by the Ministry for this season under the Horse Breeding Act, 1918.

While some further applications for licences may be received during the next three months the number issued to 21st March is only 1,414. The comparative figures at this date for the last three service seasons are 2,808 in 1922; 2,217 in 1923; and 1,664 in 1924.

After the close of the service season the Ministry will publish particulars, according to breeds, of the total number of licences issued, but the information so far available may be of interest to horse breeders :—

	No. of licences issued to 21st March.			
Service Season.	*1922.*	*1923.*	*1924.*	*1925.*
Shires	1,774	1,349	902	741
Other Heavy Horses ...	520	405	336	274
Light Stallions (including Ponies)	514	463	426	399
Total ...	2,808	2,217	1,664	1,414

* * * * * *

The "De Vecchis" Beet Sugar Process.

The process invented by Dr. de Vecchis for the manufacture of beet sugar was brought to the notice of the Ministry in 1924. The process employs the principle of desiccation, and the economies which might result in the manufacture of sugar were obvious if the claims made on behalf of the process could be sustained. The reports which came to the Ministry from various sources were, however, conflicting, and in order to obtain an authoritative and independent opinion a Commission of Inquiry was appointed and sent to Italy. The Commissioners were Mr. John Bowden, M.I.C.E., M.I.Mech.E., late Chief Superintendent of H.M. Ordnance Factories, Woolwich Arsenal; Dr. William Goodwin, Advisory Chemist, South-Eastern Agricultural College, Wye; and Dr. B. J. Owen, Director of the Institute of Agricultural Engineering, Oxford. The Report of the Commission, of which the following paragraphs are a summary, has now been published.*

The industrial extraction of sugar from beet is most generally effected by the diffusion process, in which fresh beets after washing are sliced into cossettes and treated in suitable vessels with warm water, in volume sufficient to bring about the diffusion of the saccharine juice contained in the beet cells. This juice is afterwards purified and filtered. The resulting clear thin juice is concentrated by evaporation until sugar crystals form. Molasses are separated from the raw sugar crystals by centrifugal action, the sugar is refined and put up into marketable form, and the molasses are either sold as such or subjected to a further process by which other products are extracted.

In the De Vecchis process the fresh beets are washed, sliced into cossettes and desiccated in a drying apparatus in which the moisture of the fresh beet is reduced from 80 per cent. to 3 per cent.; desiccation is continued until the membrane of the sugar-containing cells is ruptured, and the albuminoid and pectic matter coagulated. The cossettes, as they leave the drier, are rigid and horny and have about 25 per cent. of the weight of fresh beet. In this condition they can be kept in suitable store rooms for several months without fermentation or loss of sugar. The sugar is extracted from the dry cossettes by washing with warm water. This process produces a juice

* Cmd. 2343, to be obtained from H. M. Stationery Office or through any bookseller, price 9d.

high in sugar content and free from the flocculent albuminoid and pectic matter. Without further treatment by evaporation, the juice (as in the diffusion process) is boiled and cooled, and the raw sugar separated from the molasses. The refining of the raw sugar into white sugar suitable for the market, and the treatment or disposal of molasses follow on the same lines as in the diffusion process.

Raw sugar was produced at the Loreo factory during the visit of the Commission, although the plant has not yet reached a stage of regular operation, mainly owing to the unsatisfactory desiccating apparatus employed. The conditions are as yet too unstable for the cost to be verified. The possibilities of the De Vecchis process were amply demonstrated. and after careful consideration of the plant and conditions at Loreo the Commission came to the conclusion that if worked with modern machinery the cost of producing sugar by this process would be no more, and probably less, than by the diffusion process.

The process has scarcely yet emerged from the experimental stage, but the principles appear to be sound and the improvements in the plant necessary to render it commercially successful ought to present little difficulty. Once these difficulties are overcome the process would present very great possibilities for the development of the sugar beet industry in this country. Conditions in England may differ in certain details from those in Italy, and the costs of production claimed for the De Vecchis process would need to be verified in actual operation here before any encouragement were given to its adoption by the sugar beet interests in this country. The process appears to be suitable to districts where the acreage under beet is small and widely scattered, and from which the annual production would be insufficient or the distance for transport too great to justify the outlay on a diffusion factory. It should, therefore, appeal to co-operative societies of small growers or to local trading groups. There is, however, reason to believe that the system could be made to apply to large scale production, since the desiccated cossettes can be treated by the equipment common to a diffusion factory. This offers the advantage of employing the factory for a greater part of the year than is now possible. The practice of desiccating beets suggests the possibility of installing drying plants suitable for small groups of farmers by means of which beet could be dried before transport to the factory.

The Commission came to the conclusion that while the principles of the De Vecchis system were technically sound, the question of their practical application was an open one, and that until reliable costings of the De Vecchis process, working on a satisfactory industrial basis, are available, it is not possible to say whether the claims made for the system would be realisable in practice. The Commission, however, thought the system sufficiently promising to justify further experimental work, and they made the following recommendations:—

(1) A complete plant of small capacity, but on a factory basis, should be set up in England by which the De Vecchis process may be tested experimentally. The experimental plant should incorporate such improvements as to secure efficient desiccation and defecation.

(2) Experiments should be undertaken to devise a complete cleaning, slicing and desiccating equipment of a capacity suitable for operation by the beet grower.

The question of carrying out experimental work on the lines suggested by the Commission is receiving the consideration of the Ministry, and a public announcement will be made when a decision is reached.

* * * * * *

The Sale of "Red Clover."

IN the report on the working of the Seeds Act, 1920, during the 1922-23 season which appeared in this *Journal* in December, 1923 (pp. 822-829) reference was made to the undesirable but very prevalent practice of selling Red Clover under a multiplicity of names such as "Red Clover," "Cowgrass," "Single Cut Cowgrass," "Perennial Red," "Giant Hybrid Cowgrass," "Late Flowering Red," "Common Red," "Broad-leaved Red," etc. This point is further developed by Professor R. G. Stapledon in his article, "Nomenclature of Grasses and Clovers," which appeared in this *Journal* in May, 1924 (pp. 156-161). It is therefore interesting to note in the new season's catalogues of some of the leading seed merchants announcements that they intend in future to describe their red clovers under the early-flowering and late-flowering groups, and to discontinue the use of such terms as "English Cowgrass," "Giant Cowgrass," "Mammoth Cowgrass," etc. This is a move in the right direction, and it is hoped that it will be followed by all the seedsmen in the country. It cannot be too frequently emphasised that there are only two groups of cultivated red clovers: one, which it is suggested should be described simply as "Broad Red Clover," being the

kind favoured for its production of spring and winter growth, of short-lived duration and most suitable for use in short leys; and the other, which should be known simply as "Late-flowering Red Clover," a more persistent variety and therefore most useful for long duration leys or for permanent pastures. It is true that there are numerous types in both of these groups. For instance, there is the "Montgomery Red" and the "Cornish Marl," both having extra lateness and persistency as a characteristic, but these are natural selections of the late-flowering group and should be described as such, although in two such special types as these, it might be desirable to add the more specific names in brackets, for the guidance of those who particularly need an extra-late-flowering clover.

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Export Trade in Horses.

THE Minister of Agriculture and Fisheries appointed, early in March, a Committee to inquire into the conditions of the export trade in horses from Great Britain to the Continent, and to advise whether, having regard to the necessity of ascertaining that no avoidable suffering is inflicted on such horses, any further restrictions should be imposed on the trade.

The Committee is composed as follows: Major J. W. Hills (Chairman); Sir Merrik Burrell, Bart., C.B.E.; the Lady Emmott, J.P.; the Marquess of Titchfield, M.P.; the Earl of Haddington, M.C.; the Hon. E. A. St. Aubyn Harney, M.P.; Arthur Hayday, Esq., M.P.; Major F. T. G. Hobday, C.M.G., F.R.C.V.S.; Mr. H. H. Miller, of the Ministry of Agriculture and Fisheries, is Secretary of the Committee.

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Farm Workers' Wages.

THE duty imposed upon the Agricultural Wages Committees of fixing minimum rates of wages for all classes of workers employed in agriculture has now been completed so far as male workers are concerned, by the making of the necessary Orders by the Agricultural Wages Board to cover such workers in all areas. Particulars of the Orders made since the March issue of the *Journal*, are given on p. 86. This marks a definite stage in the work of the Committees and, inasmuch as it has not been necessary for the Agricultural Wages Board to fix any rates in default of the Committees reflects great credit not only upon the wisdom and tact of the Chairmen and impartial members of the Committees, but upon the conciliatory manner in which the members

representing employers and workers have dealt with very controversial questions.

A point of particular interest to the farmer is as to how far the rates now operative are stable rates upon which he may budget for the coming six or twelve months. The date of termination of the rates in each area has been given in the *Journal* as each Order has been made, but it is instructive at this stage to see the general trend of the Agricultural Wages Committees' decisions in this matter. In six areas the rates now fixed will operate for twelve months, and in six others no date of termination has been fixed. The most general period is until September or October next, and this has been adopted by 17 Committees. In three areas the present rates will expire in November; in two in December, and in one in January, 1926, the remaining areas being covered by short period Orders which will need to be replaced by fresh Orders at a fairly early date. Thus it will be seen that in 35 of the 47 Agricultural Wages Committee areas minimum rates for the whole of the coming summer are now in operation.

* * * * * *

National Survey of Markets.

THE Ministry has addressed to Town Clerks and Clerks to County Councils an inquiry as to what customary markets, fairs, wool auctions, or other periodical assemblies of buyers and sellers of agricultural produce are held in England and Wales. Preliminary information is requested on the following points :—

(*a*) The names and location of the markets held in the area concerned;

(*b*) the type of market in each case, i.e., whether controlled by a local authority or privately; whether and, if so, to what extent wholesale or retail, and how often held; and

(*c*) to whom communications in regard to the markets referred to in (*a*) should be addressed.

This inquiry arises from the following recommendation contained in paragraph 100 of the Final Report of the Departmental Committee (known as the Linlithgow Committee) on the Distribution and Prices of Agricultural Produce (Cmd. 2008) :—

"During the course of our inquiry, we have been struck by the "lack of readily available information regarding the markets of the "country. . . . As a preliminary step to the further consideration "of this question, we think it desirable that the Government Depart-"ments concerned shall collect and publish information as to the "control and ownership of markets, and any relative information likely "to be useful."

THE IMPROVEMENT OF VERY POOR PASTURES BY PLOUGHING AND IMMEDIATE RE-SEEDING.

PROFESSOR R. G. STAPLEDON, M.B.E., M.A.,
Welsh Plant Breeding Station, Aberystwyth.

THE Welsh Plant Breeding Station has an experimental farm of about ninety-six acres, the greater part of which is devoted to small scale plot trials. On this farm grazing has to be found for four working horses during the summer, and all the year round for a flock of sheep, upon which to draw for experimental grazing on plots devoted to various purposes. In order to ensure the provision of maximum grazing from fields unsuitable for critical field experiments it was therefore decided soon after taking possession of the farm to make every endeavour to convert all such fields which were in permanent grass or in out-run leys into high-grade temporary grass, the ultimate aim being to have on the farm no single field in permanent grass or under a ley of poor quality.*

It has been sought as far as possible to give an experimental character to the work of conversion; the sowing out has always been done on a plot basis and careful records have been kept of the cultural operations, and of the nature of the swards achieved, while early last year a system was initiated of registering the grazing from all the separate enclosures on the farm in terms of " sheep days."

In the main the plan adopted has been to plough the old sward and sow a seeds mixture almost immediately, either under a first and only corn crop, under rape, or without a nurse crop, and generally the large numbers of farmers visiting the station have been more struck by the palpable excellence of these swards, and, to them, the incredibly short time in which they have been established, than by any other aspect of the work in progress at the station. It is proposed in this article to give fairly complete particulars with reference to one of the most interesting fields, since it is felt that this information will be of value, not only to those who occupy farms in Wales that consist predominantly of inferior grass land, but also to graziers in general who are faced with the problem of how to improve fields of almost negligible grazing value in the shortest possible time.

* Areas obviously too water logged or too heavy to allow of even occasional ploughing, and those also which are too shallow and too steep for the plough, are regarded, and not without reason, as being unworthy of remaining in grass and are being planted with Sitka spruce and larch respectively.

The Field.—The experiment to be described was conducted in the Spring Field, a field with a north-easterly aspect, and on a very steep gradient, but not too steep, it was thought, to justify occasional ploughing. The soil was decidedly shallow, light and stony. The field had evidently been under the plough at some period in the past, since the marks of the open furrows were unmistakable. It is known, however, that the field had been under grass since 1909, and had received no treatment, manurial or otherwise, since that date, and such evidence as is available renders it highly probable that it was let down to grass upwards of twenty years ago. Botanical analyses were made on some of the very best portions of the sward during February, 1923.* The composition of the herbage on these relatively "good" portions was as follows :—

	per cent.
Bent (*Agrostis vulgaris*)	58
Crested Dog's Tail	11
Yorkshire Fog and Sweet Vernal Grass ...	10
White Clover	6
Woodrush (*Luzula* spp.)	4
Twenty other species, representing five species of grasses, one legume, and fourteen miscellaneous herbs	11
	100

In this condition the field was of negligible grazing value and was considered little, if any, better than mountain grazing. It was difficult to keep a flock of sheep on the field for more than three or four days at a time, even during the height of the growing season, while during March and April it was always necessary to supplement the meagre grazing with hay. "Sheep day" evidence subsequently obtained on another field with a slightly better herbage shows on a conservative estimate, that the field under review would have hardly come up to Pryse Howell's estimate, based on a survey of a number of farms at an average elevation of 600 ft. above sea level, with a carrying capacity of 1.1 Welsh Mountain sheep per acre.†

Cultivation Operations Previous to and at the Time of Sowing.—It was desired to ascertain whether the field could be successfully resown without very careful and deep ploughing—consequently, and with a view to expediting the work, it was tractor ploughed (one way) early in April, 1923. On the

* Twenty-six turves 6 in. x 6 in. were taken from carefully selected squares and these were analysed by the "percentage frequency" method by students as part of their practical work.

† Pryse Howell, J.: "The Productivity of Hill Farming," Oxford Institute for Research in Agricultural Economics, 1922.

basis of Cardiganshire war experiences with the tractor this would have been voted by most local farmers as an impossibility! It was necessary to leave wide headlands and these were horse ploughed. The contrast between the two methods of ploughing was very considerable—the body of the field under the tractor was very poorly ploughed—much too shallow, and the old turf was not properly buried. On the headlands the turf was completely buried under an adequate depth of soil. Harrowing was started early in May, and it was found impossible to break the soil down properly to anything approaching a reasonable depth (except on the headlands), chiefly owing to the fact that the top four inches of soil consisted almost entirely of a dense mass of roots. The final tilth was prepared by 18th May, on which date the experimental mixtures were sown. The average depth of the seed bed on the tractor area was about half an inch only and probably nowhere exceeded one inch. The seeds were sown on a dry day, covered with the chain harrow and rolled. Owing to the steepness of the field the rolling was, however, quite inadequate.

It will be apparent that the above conditions were far short of what ideally should have been aimed at for the purpose in view, and indeed the only conditions that were reasonably favourable for the establishment of the seeds were, first, that the soil was dry when the seeds were sown, and secondly, that subsequently showery weather intervened. It had been intended to apply basic slag at the time of sowing, but, owing to other pressing calls on the time of the men, this proved to be impossible. A dressing at a rate equivalent to 7 cwt. per acre of high-grade slag was, however, applied to the established sward in the second week of September, 1923.

Experimental Mixtures.—The field was divided into two approximately similar areas of about $1\frac{1}{2}$ acres each, the areas being respectively sown with the mixtures shown below:—

	Area A. lb. per acre.	*Area B.* lb. per acre.
Rape	3	3
Italian Rye Grass	6	6
Indigenous Cocksfoot	13.5	—
Commercial Cocksfoot	—	13.5
Indigenous Tall Oat Grass .	3.5	—
Commercial Tall Oat Grass ...	—	3.5
Indigenous Tall Fescue ...	2.2	—
Commercial Tall Fescue ...	—	1.4
Montgomery Late Red Clover ...	4.5	—
Chilian Early Red Clover ...	—	4.5
Wild White Clover	1.0	—
White Dutch Clover	—	1.0

Early Establishment.—The difference between the horse-ploughed headlands and the body of the field (tractor area) was very striking as soon as the seeds began to braird, and indeed can still be seen (practically two years afterwards). On the body of the field, on which it must be insisted that the seeds were obviously not covered properly, the only species to establish itself really well was Italian rye grass—the red and white clovers established themselves only fairly satisfactorily, and the two cocksfoots eventually (although very slowly) established themselves in moderate quantity, although in a manner quite disproportionate to the amount of seed sown. Both the tall fescues were to all intents and purposes a complete failure. The tall oat grasses established themselves poorly, but appreciably, having regard to the smallness of the sowing of this large seeded species. The rape took but poorly and was disappointing throughout; no doubt this round seed, even more than the clovers, must be properly anchored to the ground in order that the seedlings may establish themselves.*

The above facts add emphasis to the absolute necessity of covering small seeds properly—a point which was convincingly demonstrated by Speir† some years ago, and quite recently by Williams. The evidence also suggests the futility of including in a seeds mixture, for sowing on poor land and on a poor tilth, species other than those known to have reasonably good powers of establishment, while even in the case of the species most likely to succeed, the desirability of adding to the seed rate in proportion to the poorness of the conditions is strikingly indicated.‡

* Trials on other areas have, however, clearly indicated that rape is unlikely to succeed particularly well unless the soil is in a fertile condition or unless manures have been freely applied.

† See Speir, John: "Depth at which grass seeds should be sown," Trans. High. and Agric. Soc. of Scotland, 5th Ser., Vol. V, 1895, p. 11. See R. D. Williams: "Depth of Sowing Grass and Clover Seeds," this *Journal*, Apr., 1922, p. 53, and May, 1922, p. 132; and "Methods of Covering Grass and Clover Seeds," *ibid.* March, 1923, p. 1125, and March, 1924, p. 1134. It is of interest to remark that although Capt. Williams was unaware of Speir's investigations at the time of conducting his own trials, nevertheless both authors in effect make the same recommendations, namely, "sow when the "soil is dry, sow on a harrowed surface, cover with a peg harrow and roll well "as the final operation."

‡ See Stapledon, R. G., and Jones, Rhoda: "Seed Mixtures for Temporary Grass: Investigations Conducted in Denmark and Sweden and Observations on Trials of a Similar Nature in Progress at Aberystwyth," *Welsh Journal of Agriculture*, Volume I, No. 1, page 60.

It is interesting to note that the behaviour of the species as indicated above coincides pretty closely with what would have been expected on the basis of both the Scandinavian investigations and critical trials now in progress at the

The Grazing Value of the New Swards.—In estimating the grazing value of the newly established swards, it is necessary to do so in relation to the following periods:—

(1) Late summer and autumn of the seeding year (1923).
(2) January, February, March and April of first harvest year (1924).
(3) May and April of first harvest year (1924).
(4) July and August ,, ,, ,, ,,
(5) September and October ,, ,, ,,
(6) November and December ,, ,,

The two areas A and B were fenced separately, the original intention being to graze both plots uniformly during the first autumn and to obtain live weight increase data throughout the first harvest year. It was subsequently found impracticable to make the necessary sheep weighings, while the size of the plots was considered inadequate, and it was, therefore, decided to keep records in terms of "sheep days"; unfortunately, however, the sheep register was not started until January, 1924. During the whole of the first harvest year (1924) the plots were grazed with a control flock of Kerry Hill and Suffolk ewes (with or without their lambs according to season). The average weight of the ewes may be taken as about 130 lb. The plan adopted was to graze on an intermittent basis, putting a relatively large head of sheep on the plots (usually about 13-25) until they had practically cleared the herbage available and then resting the swards until the growth was sufficient to justify a further spell of hard grazing.*

Autumn of the Seeding Year.—Sheep were turned on the plots for the first time on 25th August, 1923, that is to say, a field of negligible grazing value had only been put out of action

Welsh Station. The outstanding ability of Italian Rye grass, and of Perennial Rye grass also, to establish themselves under unfavourable conditions, is undoubtedly one of the reasons and perhaps the chief reason—and a largely unsuspected reason—why the hill farmer and others operating on poor land adhere so tenaciously to large sowings of these grasses.

* It is beyond the scope of the present paper to discuss in detail the general applicability of this method of comparing the value of one sward with another, and it is obviously open to criticism from many points of view. It is a method, however, the ramifications of which it is intended to explore fully, and it is hoped to collect data which will make it possible to form a critical judgment alike as to its limitations and as to the uses to which it can legitimately be put—and looked at solely from this point of view the data presented in this paper are not without interest.

The following scale has been adopted with regard to converting lambs into sheep: For lambs dropped between March 10th and April 10th, one lamb equals, for the various grazing periods, the following fractions of a sheep:—May 1st-10th, 1/16th; May 11th-20th, 1/5th; May 21st-31st, 1/4th; June 1st-10th, 1/3rd; June 11th-20th, 1/3rd; June 21st-30th, $\frac{1}{2}$; July 1st-10th, $\frac{1}{2}$; July 11th-20th, $\frac{1}{2}$; July 21st-31st, 2/3; August 1st-31st, 2/3; September 1st to December 31st, $\frac{3}{4}$. Owing to the shortage of grazing on the farm, horses had occasionally to be put on the plots, the conversion then used was—one horse grazing for 24 hours = 7 sheep, and grazing for a night only = 4 sheep

for a period of about three months, at least six weeks of that period being at a time of the year when the farmer normally has available almost more pasturage than he knows what to do with.

From the grazing point of view, the only species contributing to the herbage in appreciable amount during the autumnal period were the Italian rye grass, the rape (although a poor crop) and the red clover, and considering the smallness of the sowing the sward developed by the Italian rye grass in particular was at this time the outstanding feature of the field. The difference between the two plots was not very great, except for the fact that the Chilian red clover made more growth than the Montgomery. As the former would have contributed more keep than the Montgomery during the first autumn, it was in a sense more heavily grazed than the Montgomery during this period.

Unfortunately "sheep day" records were not kept during this period, but the ley provided an abundance of grazing until early November. Results from another experiment reported elsewhere give a measure of the achievement of Italian rye grass and red clover from 14th August to 31st October, showing an average carrying capacity of six mountain sheep per acre, making satisfactory live weight increases.* The ley under consideration was advisedly not grazed to its full capacity during the first autumn, but on a conservative estimate it probably carried approximately three of the Kerry Hill ewes per acre and could have been made to carry more.†

First Harvest Year.—*Botanical Evidence.*—Practically the only species contributing in really appreciable amount to the pasturage during the period January to April was Italian rye grass, and thus the grazing on the two plots was of precisely the same order. During May and June cocksfoot began to give a quite definite character to the herbage, but since botanical analyses showed that the indigenous and commercial

* See Williams, R. D., "Winter Keep": *Welsh Journal of Agriculture*, Vol. I, 1924, p. 119.

† Perhaps an even better example of a field dealt with in the manner under review is afforded by a four acre field standing at about 900 feet above sea level at Blaentwrch, Farmers, Carmarthenshire. The field, which was steep, had not been under the plough for 35 years and was carrying a sward of negligible value. It took 15 days to plough the field, which was sown out on 17th June, 1924, with 10 lb. Italian rye grass and 8 lb. rape; 6 cwt. of 38 per cent. basic slag to the acre were applied on 28th May and 1 cwt. nitrate of soda on 18th July. Grazing commenced on 17th September, and from this date to 6th November, forty Welsh wether lambs were fattened. They were sold off at 34s. per head, their value being estimated at 24s. per head when turned on to the field. The field has maintained twenty-five store ewe lambs from 6th November last to 17th February, 1925.

strains were about equally distributed on their respective plots, it is not probable—particularly since Italian rye grass was still by far the most abundant grass—that the grazing of the plots was differentially affected by the fact that cocksfoot was represented by a different strain in each. By June, the plots showed a very decided difference in respect of the clovers. In the case of white clover, although the number of plants per unit of area was about the same for both white Dutch and wild white, the plot on which wild white had been sown showed a much denser and closer mat of white clover and had the appearance of providing actually the greater amount of herbage.

The greatest contrast was, however, between the red clovers, and this became considerably accentuated in July and August, during which period the Italian rye grass began to wane and the red clover for the first time became the dominating element in the grazing. The Montgomery plot was then manifestly throwing more red clover than that on which Chilian had been included. By September the wild white clover had fairly established itself and during this month both the white clover (particularly wild white clover), and red clover (particularly Montgomery) continued to provide probably the largest proportion of the grazing. In October and early November, Italian rye grass was again the chief element in the herbage, assisted to some extent by the clovers, cocksfoot, and such grasses as the fine leaved fescues and bent, which had come in again to a slight extent. By December daisies, ribgrass and cat's ear, also present in appreciable amount, were similarly contributing to the grazing taken by sheep.

Notes taken in February, 1925, that is to say, early in the second harvest year, showed Italian rye grass, although much thinned, still remarkably abundant on the plots, and still capable of growing quickly after grazing and once again contributing far more keep at this period than any other species. The wild white clover was well established and with very appreciable assistance from the Montgomery red and the cocksfoot it was quite evident that a sward infinitely superior to the original turf was assured for at least another three or four years, and probably for a considerably longer period. The plot on which white Dutch and Chilian red replaced wild white and Montgomery red does not look so promising, but it is apparent that on this plot a considerable amount of native and non-sown wild white has re-established itself, and it is

quite evident that it will take some years before the herbage even on this plot can revert to its original inferior character.

It is probable that the plot on which the wild white clover and Montgomery red were included was very slightly more favourably placed than the other. It was, however, noted at the time that Chilian red clover established itself quite as well as, and probably slightly better than the Montgomery: yet by October, 1924 (first harvest year), careful counts showed that there were over eight times as many plants of red clover per unit of area on the Montgomery red plot as on the Chilian red plot.* On sub-plots which had been grazed till March and then put up to hay the advantage was still with the Montgomery red, but on these hay plots the red clover was only three times as plentiful on the Montgomery as on the Chilian plots. The above facts, even if greatly exaggerated by soil differences,† afford striking confirmation of results obtained on small-scale plots repeatedly cut with a garden mowing machine, namely, that the extra late flowering red clovers stand heavy grazing altogether better than the early reds. Thus continued intermittent grazing from the moment of establishment of the ley had shown its effect to a far greater extent on the Chilian than on Montgomery red clover, and this effect still showed itself, although to a less degree, when heavy grazing was operative only during the first autumn and up to March of the first harvest year.

" *Sheep Day* " *Evidence*.—It will have been apparent from the above botanical description that the effective herbage on the two plots did not differ materially, except during late June, July and August, when the preponderance of red clover on the Montgomery plot undoubtedly had a considerable influence. In view of this, and the fact previously mentioned, that the two plots were apparently not quite equally placed as to soil, the " sheep day " results for the two plots have been averaged and give the carrying capacity of the ley as a whole (a three acre field), for the period 1st January to 31st December, 1924 (= the whole of the harvest year), as 2.9 adult—and for the district decidedly heavy—sheep per acre, compared to the previous capacity of the field which was certainly not more than 1.1 mountain sheep (of an average weight not exceeding 65 lb.) per acre.

* Based on eight readings (with a mesh 6 in. x 6 in.) on each of three representative squares.

† If the differences above noted had been solely due to soil irregularity, it would have been expected that the ratio of Montgomery to Chilian on the hay and pasture plots alike would have been about the same.

The average figures for the five periods in terms of sheep per acre were as follows:—

January-April	0.9
May and June	4.9
July and August	6.7
September and October	1.3
November and December ...	0.8

The above figures afford a striking commentary on the value of clovers, perhaps especially red clover, for summer grazing—the field actually attaining to its highest carrying capacity in July and August, a period when, ordinarily, grazing is not so plentiful as in May and June. The figures also indicate the great difficulties connected with providing herbaceous keep during the winter and early spring months. The better part of a large sheep to the acre maintained in health and without any hand feeding has, unfortunately, by comparison with the ordinary grass land of the district, to be regarded as eminently satisfactory. It should be emphasised that the "sheep days" recorded during the dead season on the ley were not "starvation" days. It was always noted that sheep turned on this or other rye grass areas were contented (of course only for a reasonable grazing period) and did not attempt to break fence, nor had they access to any appreciable area of hedge. On the ordinary permanent grass of the district it is quite impossible to retain sheep for more than a few hours at a time on a small enclosure during the winter, while the contribution made by hedges to the starvation ration afforded by such pastures must be very considerable.

General Conclusions and Recommendations.—From the particulars given as to the establishment of the seedlings it is obvious that when it is proposed to plough down a sward and immediately re-sow it with a view to producing an improved pasture, the ploughing should be deep and the turf completely buried, and every endeavour should be made to obtain a tilth of at least 2 in. in order to render it possible to cover the seeds properly. The question of the correct date for ploughing and also for sowing out is therefore important. It would in most cases be an advantage to plough earlier than April so that the old turf could be given more time to rot and the upturned soil more time to become weathered by natural processes. Within reason too the earlier the sowing out the better, so that the sown species may be given the longest possible time to establish themselves before a certain inevitable growth is made

by the old turf.* The practical objection to an earlier start is, of course, that under present systems of management every yard of winter grazing, no matter how intrinsically inferior, is regarded as of the greatest possible value.

Evidence from other trials very similar to the one here discussed lead to the almost irresistible conclusion that perhaps the chief factor making for the success of the undertaking is to apply basic slag in adequate amount, *just previous to, or at, the time of sowing*. On poor land there seems to be little doubt that slag incorporated properly in the soil does assist the seeds to establish themselves and hastens the formation of a sole to the sward more effectually than does an equally heavy dressing applied on the surface *after the seeds have taken.*

The last points to be insisted upon in connection with cultural operations (again drawing evidence from a number of trials) are, the desirability of sowing on a harrowed surface, of harrowing the seeds in with a peg-toothed harrow, and the importance of concluding with heavy rolling. Thus a dry soil and dry weather at the time of sowing are alike important.

It is evident, however, from the results given by the trial under review, that if conditions only sufficiently satisfactory to ensure a reasonable take of Italian rye grass, and but a moderate take of wild white clover,† can be achieved there is yet every prospect that a sward incomparably superior to the old turf will be produced in the course of but a few months.

The Italian rye grass may apparently be relied upon to provide good grazing until the wild white clover has fairly established itself, and until an improved semi-natural sward develops under the ameliorating influence of wild white clover.

It is not suggested that mixtures for this purpose should consist only of Italian rye grass and wild white clover, but it is suggested that such a mixture would be far more likely to be reasonably successful than a complete failure. It is further suggested that Italian rye grass and wild white clover should be regarded as the pivotal species around which all such mixtures should be drawn up, and particularly when due regard is paid to two further facts, namely, that Italian rye grass and wild white clover in their two very different ways are pre-eminent as suppressors of weeds—a very important matter when one sets out to conquer an old turf full of weeds—and that Italian rye

* It might be thought that the autumn would be a favourable season to undertake the work of conversion; trials now in progress at the station show conclusively that in West Wales, at all events, the sowing of small seeds even in August is attended with considerable risk, while to sow later is to court almost certain disaster.

† For under the combined influence of slag and abundance of bare ground wild white clover will rapidly compensate itself for an indifferent take.

grass is of outstanding value for providing winter and early spring keep.

Modifications in the mixture should first aim at putting the field out of action for as short a time as possible, and also assisting to provide winter keep. Thus there is much justice in Wibberley's* suggestion, although made in a somewhat different connection, that mustard and hardy green turnips might be introduced to replace the rape.

Further modifications should aim at providing as much keep as possible during the first harvest year, particularly when the Italian rye grass begins to wane, and the experiment under review has shown clearly that an extra late flowering red clover is superior to an early or broad red clover for this purpose, and this is substantiated by all the small scale trials bearing on the subject that have been so far conducted at the station. These have incidentally shown that of the earlies a good English strain is far superior to Chilian.†

Having regard to the cost of ploughing and other necessary cultivations the most important modifications to be made in the mixture must aim at assisting the wild white clover to form rapidly the counterpart of an excellent permanent sward that will continue productive for a considerable number of years.

Had the field under review been horse ploughed it could only have been ploughed one way, and one-third of an acre a day would have represented good work—thus it is doubtful if such a field could have been re-seeded with a reasonable mixture and adequately slagged under £6 per acre. The costs would of course be considerably reduced on less difficult fields; while in regard to all work of this sort it must always be remembered that the ploughing of old sward can be undertaken under weather conditions when normally horses would be idle and men would be performing bad weather jobs. Thus, in many cases it might with much justice be argued that the cost of ploughing would, in fact, be adequately met by a debit to cover a few ploughshares, insurance against employers' liability, and the whole or a part of the horseman's wage, according as to how economically he would otherwise have been employed.

Looked at from every point of view, however, it will be apparent that it will probably but seldom pay to break and re-sow a turf unless at least four, five or more years of greatly increased grazing can be assured—although in estimating the number of

* See "Spring and Summer Forage Crops" in *The Book of Dunns' Farm Seeds*, Salisbury, 1925.

† See e.g. R. D. Williams: "The Productivity of Different Strains and Nationalities of Red Clover under Hay and Pasture Conditions," *Welsh Plant Breeding Station*, Bulletin Series H., No. 3.

years of good sward that must be obtained to constitute a paying proposition it must be remembered that increased autumn, winter and early spring grazing has an altogether greater value than increased late spring and summer grazing.

Evidence from trials in progress at the station suggests three species in particular which can be relied upon to assist wild white clover to make a permanent sward rapidly, namely, rough-stalked meadow grass, crested dog's tail and indigenous perennial rye grass—and all of these species when fairly established exert a decided influence on the grazing available during the dead season.

It is not improbable that "ex Wild White" perennial rye grass in cases where the seed has in fact been taken off genuine old permanent pastures might alone and unaided be competent to give the necessary assistance to wild white clover. Until further trials with the commercial seed of this rye grass, now to a limited extent finding its way on to the market, have been conducted it would, however, be wiser, particularly in regions of high rainfall, to place at least a measure of reliance on crested dog's tail for the poorest soils and on rough-stalked meadow grass for poor and good soils alike.

To conclude, and acting on the very reasonable assumption that the farmer is both able and willing to experiment for himself, the writer may perhaps be permitted to suggest the basis on which a mixture for the purposes under review should be drawn up. The following mixture, per acre, with alternatives, is put forward on the assumption that the field will be grazed for the first time about 6, 8, or 10 weeks after sowing, and will be used thereafter only as a pasture :—

	lb. per acre.	
Mustard	5	or rape 5 lb.
Hardy Green Turnips ...	2	
Italian Rye Grass	6-8	or 12 lb. if rough-stalked meadow grass and crested dog's tail are excluded.
Indigenous Perennial Rye Grass	6-8	
Rough-stalked Meadow Grass*	3	or $1\frac{1}{2}$ or 2 lb. of each of these species.
or		
Crested Dog's Tail* ...	3	
Montgomery or Cornish Marl (extra late) Red Clover ...	6	The viability of these strains is generally rather low.
Wild White Clover ...	1-3	According to degree of excellence of "take" prognosticated.

* It is of some significance to note that the ordinary commercial seed of rough-stalked meadow grass and crested dog's tail does not give rise to plants differing so profoundly from true indigenous seed as is the case for instance with perennial rye grass, cocksfoot and timothy.

The experiment under review certainly suggested that for poor conditions of soil and tilth the seed rates therein adopted, even for Italian rye grass and wild white clover (successful as they were), were hardly sufficient. To be too sparing in the two pivotal ingredients would be to jeopardise the whole success of the undertaking. It must also be remembered on the one hand that the viability of the genuine Montgomery and Cornish Marl red clovers is usually considerably lower than that of Eastern Counties or foreign red clovers, and on the other hand that the powers of establishment of crested dog's tail and rough-stalked meadow grass are not particularly good, even though the viability of the seed may be excellent.

The writer is indebted to his colleagues, Capt. Williams, B.Sc., Mr. Martin Jones, B.Sc., and Mr. William Davies, B.Sc., for invaluable assistance in the conduct of the experiment and in the preparation of the data on which this article has been based.

* * * * * *

ENSILAGE.—V.

STACK SILAGE.

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Stack silage, like clamp silage, can be made without capital expenditure, nor is any preparation such as the excavation of the pit for clamp silage, generally necessary. The method can, therefore, be brought into operation at a moment's notice, as, for example, when a crop has been cut for hay and partially spoilt by rain Such a case occurred on the University Farm at Cambridge in 1924, when a partially spoilt crop of clover and ryegrass was converted into a useful stack of silage. In the same way second crops of seeds or grass at the end of summer may be converted into valuable fodder by this method, in weather totally unsuited to hay-making. Wibberley even claims to have demonstrated that a crop of mustard can be made into good silage in the stack, whereas this crop is not suitable for silage making in the clamp or in the tower silo. All these are emphatic advantages, but, as will be shown later, stack silage, unless made on a very large scale, is liable to be associated with excessive wastage by moulding on the outside.

Stack silage by reason of its exposure to air and the difficulty of thorough consolidation, favours rapid fermentation which, though producing sweet, palatable silage, may lead to excessive loss of food material during fermentation. Another consequence of such rapid fermentation, especially when irregularly distributed in the stack, is the tendency of the stack to settle irregularly and possibly to slip or overturn.

Building the Stack.—The position of the stack should be chosen both in relation to the field where the crop is grown and the use of the silage. The stack should be rectangular with rounded corners; angular corners cannot be kept sufficiently compact to prevent access of air and moulding. The dimensions should be as large as the crop to be ensiled justifies; a single large stack is preferable to two smaller ones, because it entails a relatively smaller proportion of outside exposed, and therefore less wastage. The floor of the stack, so long as it is not situated in a hollow into which water might drain, requires no layer of straw, since if dry straw or other porous material is used it tends to admit air and the silage in contact with it moulds. The silage crop is therefore stacked directly upon the earth floor.

The danger of producing sour silage at the bottom, so common in clamp silos, is not very great, but if the crop is very green and succulent it may be desirable to build the floor of slightly dried crop or to give the bottom of the stack (4-5 ft. high) a couple of days to heat before proceeding. Except in the above-mentioned case, and especially as building proceeds, the tendency will be for the temperature to rise excessively; this should be counteracted by efficient trampling when stacking the freshly-cut crop, and by stacking as fast as the settling of the stack allows.

Some makers of stack silage advocate the sprinkling of common salt over the stack whilst building proceeds, to reduce the intensity of this heating. Wibberley advocates the pouring of brine solution into a stack that is heating excessively, but the writer has no experience of either of these methods.

The walls of the stack should be almost vertical or very slightly drawn in as the stack is built, so that when the stack is complete and has settled there shall be a steep slope downwards over which the greater part of the rainwater will be shed. It is not good practice to allow the eaves to project as in a corn or hay stack, because the angles at the eaves would become completely mouldy owing to the impossibility of compressing

them sufficiently to exclude the air. During the building of the first half of the stack the centre should be kept only slightly "heartened" so that there may be no tendency for the sides of the stack to slip off; in the building of the latter part, however, every effort must be made to raise the centre so that the roof may have a considerable slope for the shedding of rainwater. The actual building of the stack is very heavy work, and where possible it should always be lightened by the use of an elevator or horse fork.

Settling of the Stack.—One of the difficulties of making stack silage is due to the fact that the stack as it heats settles enormously: the following records of a stack made at Cambridge in 1924, for which I am indebted to Mr. F. H. Hanley, B.A., will illustrate this point:—

June 9th.	Stack begun and reached 8 ft. 6 in.
June 10th.	Stack settled to 6 ft. and then stacked to 14 ft.
June 12th.	Stack settled to 8 ft. and then stacked to 14 ft.
June 13th.	Stack settled to 10 ft. and then stacked to 16 ft.
June 14th.	Stack settled to 14 ft. 6 in. and then stacked to 17 ft. 6 in.
June 18th.	Stack settled to 9 ft. and then stacked to 16 ft.
June 20th.	Stack settled to 13 ft.
July 14th.	Stacked settled to 9 ft. 6 in.
Dec. 31st.	Stacked settled to 7 ft. 6 in.

The heating and settling should be uniform, but the stack heats and settles irregularly if under the influence of continuous wind in one direction, and difficulties in adding to the height of the stack arise. Remembering that this irregular heating is generally due to continuous wind pressure driving the air into the stack on the windward side, and thus driving the heat to the leeward side, it is possible to counteract the difficulty by hanging a sailcloth along the windward side. This practice has been adopted on two separate occasions at Cambridge with silage stacks having a very dangerous lean, and in each case with the result that heat was generated on the windward side, and this settled so that the stack righted itself. The use of a sailcloth in the case of hay stacks which tend to overheat and settle unevenly is also worthy of consideration. Another method helpful in righting a leaning stack of silage consists in weighting the top of the stack on the windward side with sleepers or other weights to assist in the consolidation and settling on that side.

Covering and Pressing.—The most difficult part of the process of making stack silage is the covering and pressing.

If neither is done, then in a humid climate, especially when the stack is kept for six months, the wastage is excessive. It is not generally possible to cover the stack with earth like a clamp silo, because of the great labour of excavating the soil and elevating it, though Wibberley has described* the use of the horse fork or pitch pole elevator for this purpose, using a box on the haulage rope to carry the soil instead of the fork.

Wibberley has also recommended the practice of building a straw stack or hay stack on top of the silage stack, but the obvious objections to this are that the material may not be available at the time, and that the two stacks may not be required for use at the same time.

During the first silage boom in the 'eighties, many devices were utilised for the purpose of pressing stacks, with more or less success. An example of one of the best of these is still in use on the Reading sewage farm, where stacks of rye grass silage are annually made. In this case the pressure is exerted by means of windlasses. Parallel oak beams are placed at distances of 30 in. apart across the floor of the stack, which is built upon them, leaving the ends exposed. The windlasses are attached to these exposed ends. After the stack is completed stout poles are placed horizontally along the ridge, the middle of the roof, and the eaves to take the bearing of wire hawsers which are passed over the roof at right angles with these bearers. Each hawser is attached to a windlass on either side. The operation of the windlasses draws the wire hawsers tight, from which the pressure is distributed through the poles over the stack at the will of the operator, and these hawsers are tightened from time to time as the stack settles. This is a successful method of pressing a silage stack, but entails capital expenditure upon windlasses, etc. This description of pressing stack silage is given, not for the purpose of advocating its general adoption, but to illustrate one successful method, and to point the way for other possible modifications of the plan.

At Cambridge in 1924 an attempt was made to copy this method, but in place of the windlasses bags of soil and sleepers tied to fence wires were used; the wires were passed over the stack in like manner to the wire hawsers, resting upon parallel poles on the roof, but the method was not successful; the weights rested against the sides of the stack instead of hanging clear,

* This *Journal*, Sept., 1916: "Sweet Stack Silage," T. Wibberley.

and so failed to exert their full pressure, and mould penetrated into the roof of the stack badly.

Wastage.—Reference has previously been made to the great loss which may occur in silage stacks, especially when made on a small scale. This is illustrated in the case of the stack made at Cambridge in June, 1924. The stack was 16½ ft. wide and 27 ft. long, and in August when the stack was first cut, it was between 8 and 9 ft. high. The crop consisted mainly of Italian rye grass and clover originally cut for hay, which was washed by rain for a week while lying in the field before stacking as silage. The conditions for pressing the stack were unsatisfactory; in fact the highest temperature amounted in one place to 173 deg. F., and the very wet season contributed greatly to spoiling the exposed portions. Weighings of the amount of wastage by moulding on the roof, sides and floor were made on 23rd September, and again on 8th December. On the former occasion the waste amounted to 29 per cent., and on the latter to 35 per cent., in addition to fermentation losses amounting to an average of 10 per cent. of the good silage remaining. It is true that the resulting silage was very sweet and palatable, and that the crop as hay would in all probability have been completely spoilt by the rain. Nevertheless, although the losses were accentuated by inadequate pressure, the fact remains that they were enormous.

The conclusion to be drawn is, I think, that whilst stack silage may be a useful practice in exceptional conditions as, for example, in bad haymaking seasons, or of crops late in summer, it is not a practice to be recommended for general adoption.

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THE DOWNY MILDEW OF THE HOP.—II.

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Epidemic Occurrence in England in 1924.—Previous to 1924, the Downy Mildew of the hop had been recorded from one place only in Europe, viz., in the experimental hop garden at Wye College. During the summer of 1924, the fungus was found at the Fruit and Hop Research Station, East Malling, Kent, on some young hop plants, the cuttings of which had been obtained from Wye College in 1922-23, and grown in a nursery bed during 1923. All these plants (which had been kept isolated during 1924) whether diseased or healthy, were promptly grubbed up and burnt. Later in the summer, the disease was found in the nursery bed of hop cuttings and sets at East Malling, and the whole stock of several thousand plants was burnt.

In 1923 cuttings of other plants had been raised at East Malling in the same nursery bed alongside those received from Wye, and the former had been distributed to hop growers during the winter of 1923-24. It became necessary to visit all the farms where these hops had been planted and inspect them. Consequently the farms concerned, viz., 20 in Kent, 2 in Sussex and 1 each in Hampshire, Worcestershire and Herefordshire, were visited. The disease was found on the hops sent out from East Malling Research Station in the following cases: Kent, 16 farms; Sussex, 2 farms. On the remaining farms in Kent, and on those in Hampshire, Worcestershire and Herefordshire the disease was not found. In some cases in Kent the hops had been planted out in the farmer's hop garden, and here the fungus was found on plants adjoining those obtained from the research station. Thus at Horsmonden, the fungus was found on several hills of Fuggles, and at Paddock Wood, on Tutshams. In some instances cuttings taken from quite healthy rows of hops had been sent out, and had been planted by the farmer in a nursery adjacent to cuttings taken from his own stock, and it was a surprise to find the Downy Mildew occurring to an equal extent on both sets of plants. Whilst in many cases the disease on the farms mentioned was probably due to its introduction on plants from the research station, it seems possible, in the light of knowledge acquired later, that in some of the cases the infection proceeded from another source—particularly where nettles or wild hops occurred in the immediate vicinity. At that time, however, the facts known warranted the belief that the Hop Downy Mildew had been intro-

duced into this country on imported plants, and that therefore it was imperative that all steps should be taken to stamp out the disease if that were possible. Consequently the farmers concerned were persuaded to destroy not only all the hop plants obtained from East Malling but also in some cases rows of hops in commercial hop gardens, and also some thousands of cuttings in nursery beds, which were, or might have been, contaminated. With the loyal co-operation of the farmers the destruction was secured not only of these plants, but also of those on the other farms mentioned above, which on close examination appeared to be healthy. It was eminently desirable that the destruction of these plants should take place; and even when the situation is reviewed with the help of knowledge gained later, it seems to have been the best course in view of the possibility that different forms of this fungus may exist, some of which may cause a more serious disease than others.

Later in the season the Downy Mildew was discovered in the experimental hop garden at East Malling Research Station, where new seedling varieties raised at Wye College are tested against the commercial varieties. The fungus was found both on the leaves and on the hop cones, and with a few varieties the latter were so severely affected that the crop was ruined.

At the end of September and during October fresh facts were discovered which threw an entirely new light on the subject. At the end of September a Downy Mildew was found by one of the writers on a wild hop in a roadside hedge at Westwell, near Ashford, Kent. This led to a general search being made, and during October the fungus was found on wild hops in the following parishes in Kent: Paddock Wood, East Peckham, Wateringbury, Selling, Hastingleigh, Hothfield, Addington, Pluckley, Egerton, and between Hothfield and Ashford. Mr. J. Amos, of the East Malling Research Station, also discovered the fungus on wild hops growing on the railway bank near East Malling Halt. Some of the localities mentioned above are so far distant from Wye as to make it highly improbable that the Downy Mildew on these wild hops in the hedges could have been derived from the experimental hop garden at Wye. It was, however, desirable to ascertain whether the fungus occurred on wild hops at a greater distance from commercial hop gardens than could be the case in Kent. One of the writers therefore visited Middlesex, and after a short search found, on waste ground at Twickenham, wild hops bearing the Downy Mildew on both the leaves and cones. Further confirmation was obtained in the following way; one of the writers

was aware of the existence of a wild hop growing in a hedge at Bickington, N. Devon; leaves from this plant were obtained, and were found to be infected by the Downy Mildew. Thus in two counties where hops are not cultivated, the fungus was found on the first hops examined. It can be regarded as proved then, that a Downy Mildew of the hop plant is certainly native to, and widely distributed in, this country.

A search was then made for the fungus in commercial hop gardens generally. At that time of the year (October) the hops had all been picked, and the bines, still bearing leaves, were either on the ground or hung over the breast wires. On the youngest of the leaves, or more rarely on the older leaves, small patches of the Downy Mildew bearing summer spores could be found. In a few cases the fungus was so abundant that the under-surface of the leaf was conspicuously blackened in places by the dense, sooty-violet patches. As a general rule, however, the patches were quite small and inconspicuous, and in no case was the infestation severe enough to have attracted the attention of any hop grower. Time permitted of the search being made in only a limited number of hop gardens, but it can be stated that in those of the district between Paddock Wood and Maidstone a general infestation occurred of the nature described above. The following are the parishes in which hop gardens containing the disease were found: Paddock Wood, East Peckham, Wateringbury, Boughton Aluph, Wye, Selling.

At one farm near Paddock Wood the fungus was found on the leaves among withered hops on the pulled-down bine. In this case it was reported to us by the farmer (an experienced hop grower) that some disease of a nature unknown to him had attacked the hop cones just before they were fit to pick, had rapidly turned them brown and completely ruined the crop. The farmer had cut the bines down over some acres, in order to prevent the disease spreading. Although no Downy Mildew was observable on the withered hops when the writers visited the farm in October, it appears possible that this was a case where a commercial hop garden in Kent had already suffered from attacks of this diseases.*

* Caution is needed in attributing the cause to the Downy Mildew, because in 1924 in this, as in other hop-growing countries, a disease apparently of a physiological nature and not due to any organism appeared on the ripening hop cones and discoloured them. It seems probable that this disease, which appeared in many parts of Kent, was caused by the persistent cold, wet weather, and is the same as that described on the Continent as "la maladie nouvelle," "la maladie des houblons de 1924" and "maladie rouge" in "*Le Petit Journal du Brasseur*," XXXII, Sept. 19, 26, Oct. 10 (1924).

Visits were then made to farms where cuttings of commercial varieties of hops are raised by the thousand in nursery beds and then sold. Nurseries were inspected at Malling, Boughton Aluph, Wye and Selling, and in every case the plants were found to be more or less heavily infested with the Downy Mildew. Thus at Boughton Aluph practically all the plants (rooted sets of a Golding variety) bore numerous patches of the mildew on their leaves; at Wye and Selling the sets of Bramling, Tutshams, etc., were similarly infected. In the case of some of these nurseries the sets were already sold, and will have been distributed during the past winter to hop growers not only in Kent, but also in Surrey, Hampshire, Worcestershire and Herefordshire. In one such instance it is not too much to say that every plant was more or less affected with the Downy Mildew. The injury to the leaves was negligible, and the disease under the circumstances would be passed over by the average practical man; on the attention of the grower being called to the spotting of the leaves caused by the disease, it was dismissed by him as being nothing new, of no importance and due to the natural "ripening off" of the plants. There is the probability therefore that every batch of plants sent out from this nursery (as well as from others) has carried winter spores in the soil attached to the roots, either in fragments of leaves or free in the soil. The possibility also exists that the fungus may have been transported in the form of spawn in the stem or in its buds.

Leaves of hop sets from nurseries on various farms in the Weald of Kent and in Herefordshire were also examined and found to bear the Downy Mildew.

On the greater number of the farms mentioned above, where the Downy Mildew was found in commercial hop gardens or in nurseries, no hops from either Wye or East Malling Research Station had been planted, and it was quite certain that the disease had not been introduced from either place but was occurring spontaneously. Certain facts observed on the farms visited, and elsewhere, gradually led the writers to suspect that the source of the disease existed in a very unexpected quarter. A Downy Mildew attacking nettles has long been known in this country, and during the wet autumn of 1924 was extremely prevalent in Kent, both on the Perennial Nettle (*Urtica dioica*) and on the Annual Nettle (*U. urens*). Leaves attacked by this fungus show dark angular spots similar to those caused on the hop leaf (compare Figs. 3 and 9). In the hedges surrounding Kent hop

gardens, and in most hop nurseries, nettles of both the perennial and the annual kind occurred in abundance, and it was a comparatively rare occurrence to find nettles free from the attacks of the Nettle Downy Mildew. A suspicion that the Nettle might be concerned in the sudden appearance of a Downy Mildew on the hop was strengthened by the fact that it was by no means an uncommon occurrence to find nettles bearing the Downy Mildew in the closest proximity to hop plants, both in nurseries and in roadside hedges. Sometimes the stem of the hop was twining round the nettle stem, and in one such case the hop plant was also affected with a Downy Mildew, the other hop plants near-by being healthy.

Under the microscope the Downy Mildew of the hop was found to be identical in structure with that on the nettle, except that the winter spore (*oospore*) of the former was slightly larger.

Attempts were made to establish the identity of the two Downy Mildews by making cross-inoculations, *i.e.*, taking the fungus from the hop and putting it on the nettle, and vice versa. Although the season was late for such work, and there was scanty time for obtaining the most suitable plants, the results of the experiments (which are published elsewhere in detail*) appear to show that the Downy Mildew of the hop can infect the nettle. Of 45 leaves of the annual nettle which were inoculated with summer spores of the Downy Mildew taken from the hop, six leaves became infected; of 27 leaves of the perennial nettle inoculated from the same source, five leaves became infected. In both sets of experiments the control leaves remained healthy. Conversely, of 62 leaves of the hop inoculated with summer spores of the Downy Mildew of the nettle, eleven leaves became infected. In these experiments, however, three control leaves showed the disease, so that here the evidence becomes less trustworthy. Attempts will be made during the season of 1925 to place the question beyond doubt.

General Considerations.—The underlying causes of the recent appearance of this new disease of the hop must remain at present a matter of speculation. Two alternative theories may be advanced. The view may be held that the serious disease observed in the experimental hop garden at Wye College for the past five years and described above has been caused by a specialised and virulent form of the Downy Mildew

* *Annals of Applied Biology*, Vol. XII, No. 2, 121-150 (1925 *in the press*).

possibly imported into this country from abroad. This virulent form might be distinguished by its persistence on or in the hop plant during the winter, as the result of which the fungus appears year after year from the commencement of the growing season, and is thus able, given suitable weather conditions, to inflict the most serious injury on the crop. If the commercial varieties grown in this country are as susceptible to the fungus as those grown in the experimental hop garden at Wye have proved to be, it is quite certain that hop growers have had up to the present no experience of this disease, as it could not have occurred in their hop gardens without attracting attention. On the same theory the Downy Mildew which was observed in epidemic form during last autumn may be supposed to be another form of the same fungus (probably originating from the nettle and certainly native to this country) which possibly under certain weather conditions and late in the season can temporarily infect the hop plant, attacking the leaves and the cone, but not causing a permanent disease. On this view the hop plants would each year, and only under certain weather conditions, be infected afresh from diseased nettles. Such a temporary infection late in the season either in the hop garden or in the nursery would cause no appreciable harm and may well have occurred in this country in previous years without having attracted the attention of either the farmer or the scientist.

On the second theory, the fungus originally causing the disease at Wye and that found in the general epidemic of 1924 are assumed to be the same, to be native to this country on the nettle, and on this host within recent years, to have "sported" and developed a form capable of attacking the hop in such a way that it reappears year after year in the hop garden as a dangerous disease. If this view is correct, the events which have been noted since 1920 in the garden at Wye College seem likely to be repeated during the coming years in many a hop garden in Kent. The amount of injury then caused to the hop crop will depend on the susceptibility shown by the different varieties cultivated.

In the event of the disease being observed by any hop grower, it is desirable that the nearest technical advisory centre, or the Ministry, should be immediately informed.

Summary.

1. A description is given of a new and dangerous disease of the hop, caused by the Downy Mildew (*Pseudoperonospora Humuli* (Miyabe

and Takah.) Wilson), which was first noticed in this country in 1920, in the experimental hop garden at Wye College, Kent, and which has persisted from year to year, and caused considerable injury to the crop. In a previous article in this *Journal* (vol. XXX, 430 (1923)) the belief was expressed that the fungus causing this disease had been imported from abroad.

2. In 1924 a fungus indistinguishable from the above appeared in epidemic form during the autumn in hop gardens, hop nurseries, and on wild hops in the hedges, in several counties in England under circumstances which showed that the fungus was a native of this country.

3. Investigations have shown that the Downy Mildew which is common on nettles is almost identical with that on the hop, and that it is probable that the fungus can pass from the hop to the nettle and *vice versa.*

4. Two theories are advanced to explain the appearance in England within recent years of this new disease of the hop.

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AGRICULTURAL RESEARCH IN FRANCE.

A COMPARISON WITH GREAT BRITAIN.

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THE modern development of agricultural research in France is even more recent than in Great Britain, for whereas in the latter case it dates from the Development and Road Improvement Funds Act of 1909, the charter in the former case is the French Finance Act of 30th April, 1921. This law created at the Ministry of Agriculture an "Institute of Agricultural* Research" charged with the duty of "developing scientific research applied to agriculture with the view of increasing and intensifying agricultural production." There were a number of agricultural stations in existence previous to the establishment of the Institute, but they were badly staffed, research work was largely sacrificed to analytical work carried out to secure fees, the whole field of agricultural science was not covered, and the local stations were unevenly distributed over the country. The Institute has the task of thoroughly reorganising the agricultural research work, and of placing it on a satisfactory footing.

Status of Research Stations and Nature of Research Grants. —In France agricultural research is largely a strictly Govern-

* Agronomique has throughout been translated as "agricultural."

ment service. There are now some 88 stations and laboratories in that country, 58 of which are Government stations staffed by Government servants and controlled by the Institute of Agricultural Research. The chief centres are Paris, Versailles, Bordeaux, Clermont-Ferrand, Grignon, Montpellier and Rennes. In Great Britain, however, the policy has been adopted of entrusting agricultural research to research institutes either independently governed, or attached to Universities, grants in aid of expenditure of such institutes being made from Government funds (the Development Fund).

The French stations which are not Government stations belong mainly to local authorities. The practice as regards grants by the Institute to these stations is very much the same as in this country. The French Agricultural Research Institute gives grants (1) to university laboratories and other independent institutions, (2) to agricultural stations of the various departments, (3) to individual scientists working on agricultural problems. The first corresponds to British research institute practice, the second to grants to local authorities in this country for experimental work, and the third to special grants given in this country to individual investigators (through their institutes) for agricultural research into specific problems.

Governing Body.—The governing body of the French Agricultural Research Institute is the Administrative Council, on which the representatives of the Ministry of Agriculture have a majority—of the 28 members, 6 are nominated by the Academy of Science, 6 by the Academy of Agriculture and 16 by the Ministry of Agriculture. Of the nominees of the Ministry of Agriculture, 3 are Members of Parliament, 3 are agricultural or scientific notabilities, 3 are members of agricultural associations, and one represents the Ministry of Finance. The Director of the Agricultural Research Institute is an additional member of the Council; this appointment is made by the Ministry of Agriculture.

The Council's deliberations relate to financial and accounting matters; acceptance of gifts and legacies (the Institute is empowered to receive these); investment and borrowing of funds; the use of funds given to the Institute by local authorities; the formation or suppression of stations; the budgets and accounts of individual stations; and all questions concerning the personnel and work of the stations. The decisions of the Council can only be put into effect after approval of the Ministry of Agriculture.

So far as its deliberative functions are concerned this Council corresponds to some extent to the British Agricultural Research Council (composed, however, for the most part of directors of research institutes in England, Wales and Scotland), which meets for discussion of questions concerning research work. The administration of grants to institutes, and financial arrangements generally are in this country, however, retained by the Ministry of Agriculture and the Board of Agriculture for Scotland respectively. On technical questions the British Agricultural Research Council has another counterpart in France—the meeting of directors of stations. This question is further dealt with below under " co-ordination of research work."

Subject Division for Purposes of Research : Research Programmes.—The policy adopted in this country of dividing up the science of agriculture into subjects for the purpose of research, and of entrusting each subject to a different station, is being followed in France. The following is a comparison of the subject divisions :—

Great Britain.	*France.*
Soils (Plant Nutrition).	Soils.
Plant Pathology.	Entomology. Mycology.
Plant Physiology.	—
Plant Breeding and Crop Improvement.	Plant Breeding.
Horticulture.	—
Glasshouse Crops.	—
Animal Nutrition.	Animal Nutrition.
Dairying.	—
Animal Breeding.	Animal Breeding.
Animal Pathology (including Agricultural Parasitology).	Animal Pathology.
Agricultural Economics.	—
Agricultural Engineering.	Agricultural Engineering.
—	Agricultural Physics and Meteorology.
—	Agricultural Bacteriology.

The chief apparent omissions in the French programme compared with the British are plant physiology, horticulture, glasshouse crops, dairying and economics. Some of the British work on plant physiology corresponds to work allotted in France to the agricultural physics and meteorological stations. Doubtless too a good deal of the work carried out at our horticultural and glasshouse crops stations will in France be conducted at the stations for plant pathology and plant breeding; similarly dairying

work may also be carried out at the animal nutrition and breeding stations, and is dealt with to some extent at the bacteriological station (see later). Agricultural economics does not come within the French Agricultural Research Institute programme because it is entrusted by the Ministry of Agriculture to its Agricultural Intelligence Office; very little seems to have been done on this subject, however, and there is no provision for dealing with costing records by localities as in this country.

There are no separately recognised stations in this country for either agricultural physics and meteorology or agricultural bacteriology. The French research programme in agricultural physics and meteorology is thus defined: "Research into methods of using natural forces—whether thermal, actinic, electrical, magnetic, radio-active—in the development of plants. Research into methods of protecting crops against harmful meteorological phenomena, *e.g.*, frost, hail, etc. Research on the utilisation of meteorological observations in forecasting crop yields, and in predicting outbreaks of plant disease for the purpose of forewarning farmers."

In our own country work on soil physics is carried out at Rothamsted, and the Agricultural Engineering Institute at Oxford will also be concerned in the question. Agricultural meteorological work has been carried out hitherto in rather haphazard fashion, the principal station concerned being Rothamsted; observations have, however, been made elsewhere, *e.g.*, Cambridge, Cockle Park, Wisley, Newton Rigg, etc. Under a scheme now inaugurated by the Ministry (of which full particulars will be published elsewhere) this country is covered with crop weather stations at which both meteorological and crop observations (including phenological and plant pest observations) will be carried out, and attempts will be made by an *ad hoc* Standing Committee of the Ministry to correlate the two sets of observations. There is also a Committee of the Ministry for electro-culture research, carried out under the direction of the Plant Physiology Research Institute.

The following work is allocated to the French Agricultural Bacteriological Station: research for improving the fermentation industries, *e.g.*, wine making, cider making, brewing, distilling, vinegar making, cheese-making, butter-making, and flax retting. Work under these heads has not been brought together in this way in this country. Cider making is dealt with at the Long Ashton Research Station; brewing and distilling research is carried on by the Institute of Brewing, which, instead of receiving

a subsidy from Government funds, itself subsidises agricultural research on problems bearing on the brewing industry; research in cheese-making and butter-making is carried out at the National Institute for Research in Dairying; research into problems of flax and linen has hitherto been dealt with principally by the Linen Industry Research Association, which receives support from the Department of Scientific and Industrial Research and the Government of Northern Ireland.

The work to be dealt with in France under soils, plant breeding, animal breeding and animal pathology sufficiently resembles the programme of research institutes dealing with these subjects in this country to need no comment.

As regards agricultural entomology (zoology) it may be noted that, as in this country, bee-keeping is included, but the zoological programme in France is wide enough to include ornithological research directed to the protection of insectivorous birds and the destruction of harmful birds, and research into methods for the destruction of rats and mice and other small harmful animals. Of importance in France also is research in silkworm rearing. In this country rat destruction research is a matter in which the Ministry of Agriculture has directly concerned itself.

The mycological research programme in France is wider than the usual conception of such research in this country in that, in addition to dealing with fungus and bacterial diseases, it includes the destruction of weeds and parasitic plants and destruction caused by physical agents.

The French programme of nutrition research covers both animals and man, and includes research into poisoning, a subject which in this country is usually regarded as coming within the purview of animal pathology research institutes (so far as animals are concerned).

The agricultural engineering research programme in France is defined simply as the testing of motors and agricultural machines, apparently indicating a conception of the work less fundamental than in this country.

Co-ordination of Research Work.—Akin to the British Agricultural Research Council from the point of view of co-ordination are periodical meetings of the directors of French agricultural research stations and laboratories. Such meetings are held by the Council of the Institute to be desirable "because they lead to a closer and more efficient scientific collaboration between institutions whose programmes have many points in common, and aim at the same ends; it is often by an interchange of views

between technical men specialising in the same branch of knowledge that a method of analysis or a new process is brought to the test." Judging by the following list of the principal questions discussed at such a conference in 1923, it might have been held on British soil:—Agricultural soils and mapping; improvement of analytical methods; new manures and old methods of valuation; crop experiments; collaboration of chemist and geneticist; the importance of minute quantities of chemical compounds; analyses of feeding stuffs. A second meeting of station directors is to be held in Paris in April, 1925.

In order to ensure proper co-ordination the Administrative Council of the Institute has five technical committees: (1) Soils, (2) plants, (3) hygiene and feeding, (4) engineering, and (5) physics and meteorology.

The aim of the French Government is to have one central station for each of the ten groups of subjects into which agriculture has been sub-divided; it will be the duty of each of these central stations to co-ordinate the efforts of all the stations working on subjects within its group and to centralise the results. This does not, however, mean that the latter stations will be subordinate to the central station; they will retain their independence both administratively and technically, and will not necessarily become provincial dependents of the central station.

It is interesting to compare this aim with practice in this country. In subjects in which there are two or more research institutes, *e.g.*, soils, horticulture, plant breeding, animal nutrition, animal breeding and animal diseases, there is no question of any one station being regarded as subordinate to others; each preserves administrative and technical independence. Provision for co-ordination of work is made as already mentioned through the Agricultural Research Council, through frequent meetings of directors apart from the Council, and through special committees in the case of horticulture and animal diseases. A special arrangement obtains in this country as regards poultry: although feeding and breeding are dealt with at the different research institutes in these subjects, the work is co-ordinated and centralised in the National Poultry Institute. Somewhat closer co-ordination and centralisation has been adopted here, especially as regards crop improvement research and agricultural economic research. In the case of crop improvement, stations entirely subsidiary, technically, to the National Institute of Agricultural Botany have been established in various localities, and in the case of agricultural economics the work of advisory officers in

agricultural economics (who carry out economic investigations in the different provinces) is centralised at the Oxford University Institute for Research in Agricultural Economics. The organisation of provincial advisory officers in plant pathology is also used for co-ordinated work on any particular plant disease problem, and, so far as advisory officers generally are concerned, conferences are regularly held to ensure proper co-ordination of work. Further, a scheme has been inaugurated for research in pig husbandry in which research at several stations will be co-ordinated and centralised at the Animal Nutrition Research Institute at Cambridge. The practice of Research Institutes themselves establishing centres to test a particular problem seems to be growing in this country; it has been adopted notably by the Rothamsted Station and the Welsh Plant Breeding Station.

While dealing with the question of the co-ordination of experimental work, mention must be made of the action of the Ministry in preparing schemes of work on such subjects as agricultural meteorology, grassland improvement, and potato varieties. In general, co-ordination of experimental work carried out by agricultural colleges and county agricultural education authorities is regarded as a function of the Provincial Conferences—bodies principally composed of representatives of these colleges and authorities.

Practical Application and Publication of Results.—Arrangements have been made in France for linking the research station with farming practice. As soon as a result has been obtained by a research station which appears to have practical application, experiments under practical conditions are to be carried out jointly by the research station in question and the "Agricultural Offices" of the local authorities (departmental and regional) in France; the experiments are to be carried out for a sufficient length of time to test thoroughly the point under consideration. If the experiments confirm the research station results it is then the duty of the Agricultural Offices to popularise the methods or products by carrying out demonstrations. It is hoped in this way both to prevent premature recommendation of discoveries with consequent mistrust of scientific methods, and to secure publicity for results of proven value. The local stations, independently of this work for central research stations, carry out trials under practical conditions of methods, processes and products (including crop varieties) the use of which it appears might be of value locally. Such stations are also entrusted with

the work of multiplication of varieties and their sale; for the latter purpose associations of farmers willing to use improved varieties are formed.

In England and Wales there are various links between the results of fundamental research at the research institute and their application by the farmer in actual practice. The chief are the specialist advisory officers in various subjects (plant pathology, chemistry, economics, veterinary science) who carry out local investigations in which the fundamental results obtained at agricultural research institutes are applied to local conditions, and who also give advice; and the agricultural organisers and staffs of local agricultural education authorities, whose duty it is to keep abreast of current research for the purposes of their advisory work among farmers (which includes lectures, visits of advice, and demonstrations). Results of research also find a place in the agricultural press, and in this connection the *Journal*, leaflets and miscellaneous publications of the Ministry play an important part. Arrangements have been made recently for special series of lectures on research work to be delivered to audiences provided by the National Farmers' Union, and to be broadcast by the British Broadcasting Company.

An arrangement which does not obtain in Britain is made in France regarding the publication of research work. The Institute of Agricultural Research has two official organs for the purpose: the *Annales de la Science Agronomique*, and the *Annales des Epiphyties*. These are devoted to the results of all research work of interest carried out in the stations and laboratories of the Institute, and it is proposed that they shall also contain as complete a summary as possible of agricultural scientific work carried out in France and abroad. At present the accounts of such work are scattered among a host of publications of which the majority appear irregularly or have not sufficient agricultural interest to justify regular subscription. The Institute holds that it would be advantageous for many of these publications to disappear and for the work to be centralised as proposed. The present view in this country is that so long as the practical application of results of research work appears in the Ministry's *Journal*, leaflets, or miscellaneous publications, or in the agricultural press, agriculturists' needs are fully met, and that scientific workers are best left to publish an account of their work from the scientific point of view in the many scientific journals which

exist for the purpose. It must be remembered that the summarising of the results of research abroad is a very costly undertaking, and existing agencies are already at work on the task, viz., the International Agricultural Institute and the United States Department of Agriculture (which publishes the Experiment Station Record).

Finance of Research Work.—The funds at the disposal of the French Institute of Agricultural Research consist of sums previously available annually, and now transferred, for the payment of salaries of personnel, maintenance of Government research stations and laboratories, and for subsidising other research stations, etc., together with a new annual sum of two million francs provided for the purpose of filling up gaps in the research scheme by additions to stations, staffs, buildings and equipment. The budget of the Institute forms part of that of the Ministry of Agriculture, and amounted in 1923 to 4,472,000 francs; but to this must be added the receipts from certain taxes, subsidies from local authorities for the upkeep of stations and fees for analyses, bringing the total for 1923 to 5,561,000 francs. The expenditure in that year amounted to 4,079,000 francs so that there was a considerable sum unspent, unforeseen delays having occurred in the commencement of various building operations. The excess of income over expenditure is invested for the future benefit of the Institute. The total funds at the disposal of the Institute in 1924 exceed 6,000,000 francs.

This expenditure compares with a total expenditure from Government funds on agricultural research in England and Wales in 1923-24 of some £158,000 (this sum excludes expenditure on specialist advisory work and also grants in aid of experimental work by local agricultural authorities). Of this sum £140,000 was spent in grants in aid of capital and maintenance expenditure of Research Institutes.

The sums spent in France on upkeep of Government stations and in subsidies towards the upkeep of other stations amounted to 3,400,000 francs (of which salaries accounted for 2,455,000 francs). In addition sums were spent as follows in 1923 in completing equipment of stations: Machinery Testing Station (Paris), 80,000 francs; Veterinary Research Laboratory (Alfort), 92,400 francs; Phytopathological Station (Paris), 14,000 francs; Insectary (Mentone), 26,700 francs; Food Hygiene Station (Paris), 125,000 francs. The administrative council of the Institute has adopted the policy of concentrating agricultural research at certain centres. Thus at Versailles

buildings are being erected to house stations for the following :—plant pathology (zoology and mycology), plant breeding, soils, agricultural physics and meteorology; at Bordeaux for the following :—entomology, mycology, physics and meteorology, oenology: at Clermont-Ferrand for physics and meteorology, entomology and mycology.

The cost of the building at Versailles is estimated at 1,708,000 francs, and 17,000 francs has already been provided for working capital for the 42 acres of arable land attached to the centre. A building near Bordeaux has been acquired by means of a fund of 200,000 francs placed at the disposal of the Agricultural Research Institute by the Department of Gironde; and a building near Clermont-Ferrand has been acquired as the result of the provision of a sum of 200,000 francs by the Department of Puy-de-Dôme.

Subsidies to individual workers in 1923 amounted to 149,000 francs; this compares with special research grants in England and Wales in 1923-24 amounting to £3,094. In France, individual agricultural workers benefit in this way from other sources; an additional 254,000 francs was given in 1923 by various bodies. As the result of action by the French Academy of Science a general review of grants so made will be carried out each year in order to avoid duplication and over-lapping.

A statement made by the President of the Administrative Council of the Institute is worth quoting: "The funds at present placed at the disposal of the Institute are insufficient to permit it to carry out efficiently the work which it has undertaken: there will be a loss of precious time to agriculture, which hopes so much from scientific research and which impatiently awaits the solution of a large number of problems which it has placed before the Institute. It must be realised that the Institute will be able to obtain its own resources only very slowly. The problems on which it is engaged are of too general a character for their solution to serve the interest of any particular groups of agriculturists from whom support could be claimed. It is thus on the whole nation, *i.e.*, on State funds, that the Institute will have to rely for some time."

Staff.—The superior administrative staff of the Institute, who are civil servants, comprise a director, a "chef de bureau," a deputy chef de bureau, and an accountant.

The superior staff of the stations and laboratories comprised in 1923, 3 general inspectors, 3 directors of central stations, 52 directors of laboratories and 28 deputy directors. Of these,

8 directors, 6 deputy directors and 11 assistants were lent to subsidised stations : this is held to be a most effective way of aiding such stations.

The total salaries of the staffs of stations belonging to the Institute or lent to subsidised stations amounted in 1923 to 2,455,000 francs.

The recruitment of the technical staff presents great difficulties on account of the low commencing salary—6,000 francs. At the last examination for these posts two-thirds of the candidates were women, and the first three successful candidates were women. This is causing some anxiety as regards the supply of trained workers for the higher posts, since the majority of the women may be expected to marry and give up the service.

There seems to be no system in France for providing suitable recruits by means of Agricultural Research Scholarships in various subjects such as are offered in this country.

Very few women enter the research service in this country.

Research workers entering the French service probably compare with non-graded workers in this country, for whom there are no fixed rates, but who seldom rise above £300 per annum. The rates, however, fixed for graded research workers in England and Wales are :—Assistant. £300-£360 per annum; Senior Assistant, £400-£600 per annum; Principal Assistant, £600-£800 per annum—in each case with a small bonus varying with the cost of living, at present averaging about £45 per annum. The salary of Directors of Research Institutes in this country is in no instance less than £800.

The staffs of Research Institutes in this country are not in any way Civil Servants; they are employees of the governing body of the Institute.

Conclusion.—It will be seen that there are very many points of similarity in the organisation of agricultural research in Great Britain and in France. If, in France, there is a greater tendency to centralisation, this is not so great as we might expect having regard to the administrative history of the country. The looser organisation traditional in this country is gradually being tightened up, but not in such a way as to impair the freedom of the workers. Both as regards their personal emoluments and the provision of equipment, the research workers in France, even allowing for different standards of living and prices, seem to be at a disadvantage financially compared with research workers here, where as a nation we are not supposed to have a high regard for the claims of science.

CULTIVATION OF THE VEGETABLE MARROW.

Origin and Description.—The species and varieties of marrows, to which the gourd and pumpkin belong, are very numerous, and are all classed as tender or half-hardy annuals. They are monœcious, that is, the male and female flowers are distinct, but are borne on the same plant. All are natives of the warm parts of both hemispheres, and particularly India. Being hardier than their allies, the melon and cucumber, they succeed well as an outdoor crop in this country in ordinary seasons, providing an open sunny position is afforded, and high bleak situations are avoided. Although tender, the marrow is most accommodating in its requirements, and will grow in almost any kind of soil in which the roots can run freely and a sufficiency of moisture can be maintained, for the plant will not stand dryness.

Varieties.—Varieties of marrows cross so readily with each other that great difficulty is experienced in keeping any one variety distinct if other sorts are growing in the near neighbourhood and flowering at the same time. The abundant pollen grains are freely transmitted by wind and other agencies, as, for instance, the bumble bee, while not infrequently domesticated bees show a special taste for foraging on marrow flowers.

The varieties most favoured for garden or field culture are the Long White and Long Green, both smooth and ribbed, and they may be of either the bush or trailing types. There are various strains of these, some of which are quite distinct in shape, colour and texture of the fruit, as well as in freedom of cropping and earliness. Again, foliage and habit of growth are characteristic of some strains. The finely cut foliage of one, or the more rounded glaucous and marbled leaf surface of another is suggestive of their near relationship with the ornamental gourds and umpkins of the Continent. These special types are generally to be found in the principle marrow-growing areas of Worcester, Bedford, Cambridge, Cheshire and the home counties, and are obtained from seed saved by growers from selected plants.

Propagation from Seed.—Well ripened seed is essential. Some growers who select and harvest their own seed prefer to use two-year-old seed, which, when kept carefully, becomes fully ripened and matured. As a means of encouraging quick germination, the seed may be placed in a canvas bag and soaked

for twelve hours in tepid water, or it can be spread out in thin layers in shallow boxes, moistened, covered with damp moss, fibre, or leaf mould, and placed in a warm greenhouse or store for thirty-six hours.

Two methods of raising plants from seed are usually practised:—

(1) Sowing the seed in pots under glass in early spring for transplanting to heated boxes and lights, frames, or heated pits for early cropping.

(2) Sowing the seed in the open where the plants are to produce their crop.

(1) For the first method three-inch pots filled with a compost of leaf mould, sand and loam in equal parts, or, failing this, any good garden soil, made light and porous by a mixture of sand or brick rubble, will suffice. Two seeds should be put in each pot in March, and covered with soil to the depth of 1½ in., placing the seeds as far apart as possible near the edge of the pot. As the seedlings appear they should be kept close to the glass to encourage sturdy growth, the stronger plant being eventually retained in each pot and the other pulled out. In the Evesham district three or four seeds are sown in a pot.

On the appearance of the first pair of rough leaves the plants should be planted out in their fruiting quarters in boxes and lights, frames, or pits, in which some form of heating can be controlled either by a fermenting material or by hot water pipes. To maintain a safe night temperature, covering in the form of mats, straw or bracken is necessary during cold spells of weather. The white bush form of marrow is most suitable for early cropping under glass.

(2) Marrows are usually sown in the open in May. The usual method is to excavate shallow holes 1½ to 2 ft. in diameter and 8 to 9 in. in depth, placing in the bottom two or three spadefuls of good well-rotted manure or other decaying vegetable refuse. Fresh manure should not be used. This is then covered with 8 to 9 in. of the excavated soil, or if the soil is poor or low in friability, by a top spit of good decayed turf. On filling in, a shallow mound will be left, on the top of which three seeds in the form of an equilateral triangle 8 to 10 in. apart should be buried 1½ in. deep. The resulting plants when in rough leaf should be singled so that one plant remains to each mound. Pot-raised plants for outdoor cropping may be planted out in a similar manner or singly on the flat.

Protection in some form is necessary for the seed beds and for the plants after they have been put out. Failing bell glasses

or hand lights, a ring of sheet tin or zinc, 12 in. in diameter and about 4 to 6 in. in depth, put over the seeds and covered with a sheet of glass weighted down with a stone, will suffice. Such protection is necessary for seed sown in April or early May, or for plants put out about this period. For later sowings or planting out at the end of May, inverted plant pots, bushel baskets, or oiled paper (thin wrapping paper dipped in linseed oil) form sufficient protection as a night covering until the danger of frost is past.

General Cultivation.—Marrows, whether they be grown in frames or in the open, respond to generous treatment, and will well repay the grower for the extra care and cost involved in providing for the crop as many favourable conditions as possible. Frame culture is of considerable importance because early marrows are much valued, and often realise high prices. Three conditions are essential to success in growing them under more or less artificial conditions :—

(1) A moderate bottom heat from fermenting material, and hot water pipes for top heat.

(2) A mellow loamy soil, in which the roots can run freely.

(3) Sufficient water, for the marrow is a thirsty plant, and the more vigorous the growth the more satisfactory the result.

In Frames.—The temperature for early marrows in frames may range from 55° F. to 80° F., the safe medium being about 65° F. when the weather is cold and dull, up to 80° F. when strong sunshine prevails and the plants are growing freely with plenty of air. The crop must be ventilated freely on all favourable occasions.

Regular supplies of water (at the same temperature as the pits) must be supplied so that the bed is always reasonably moist, care being taken not to direct the water on to the main stems of the plants. A light spray of water over the foliage before closing down in the evening is also beneficial. Care should be exercised in the regular use of water, for failure will result in a deficiency of fruit. A little soot occasionally sprinkled around the young plants and over the soil surface will help to ward off slugs and will stimulate the crop. If the plants show signs of weakness liquid manure should be applied to the soil around them. Sulphate of ammonia and superphosphate can be applied at the rate of 1 oz. to the square yard and watered in.

If trailing varieties are grown the training out of the plants is a simple matter. They should run their own way until they have made shoots eighteen inches long, then the points should be nipped out, after which there should be no more stopping, but

occasionally the laterals must be suppressed to prevent crowding. The point at which the plant should be stopped is determined to some extent by its vigour, and some growers do not stop shoots until they are 3 to 4 ft. long. Bush marrows should not be stopped.

To ensure an early set of fruit, hand fertilisation should be resorted to as soon as the fruit flowers (female) appear. It will generally be found that the male flowers are the first to appear, generally in clusters near the base of the main stem or shoots.

In the Open.—If seed is sown outside generous treatment is equally important. Where land and labour are costly, and the summer season not too certain, it pays to provide every possible favourable condition for the crop.

If one can choose, a black soil is to be preferred, as such soils are warmer and more favourable to the early growth of the plant than a heavy loam or clay soil, though both of these can and do produce good crops of marrows when deeply worked and liberally treated with organic matter.

The marrow crop usually follows a crop of late brassicas, such as sprouts, savoys, or cauliflowers. These crops coming off the ground early in the year allow the grower time to work the land well and obtain a good tilth. Marrows benefit by shelter during their initial stages of growth, and can be grown with advantage on " lands " divided by " breaks " of broad beans.

The average distance allowed between the rows of bush marrows is 4 ft., and between the plants 3 ft., whilst the trailing varieties may be 4 ft. between the plants, and at least 8 to 10 ft. from row to row. With the latter, intercropping with catch crops of lettuce, radish, spinach or early turnips can be carried out, allowing two feet between the intercropping rows for horse hoeing and surface cleaning.

Providing the soil has been deeply worked, and contains plenty of humus, and a surface tilth is kept up, it should be sufficiently retentive of moisture to carry the plants on until they have formed a good root system, and have sufficient foliage to shade the ground. If, however, there should be a partial or absolute drought during the early growth of the plants it may be necessary to water them, but this should be done with great caution. It would be better and certainly safer to apply a light mulch of short litter or half decayed vegetable refuse, and if water must be used as a last resort, to leave it first exposed for some hours to the air in open tanks or barrels. Mulching

also serves to protect the marrows from being splashed with mud during heavy rain.

When the plants commence to fruit an occasional dressing of sulphate of ammonia and superphosphate can be given at the same rate as for the frame crop, or fish guano, at the rate of 1 oz. per square yard, may be hoed in between the rows of plants.

Cutting the Crop.—The marrows should be cut when quite young, the earliest fruits being about 8 inches long when marketed, and in no case should they be allowed to remain on the plant beyond medium size. The production of the young fruits does not to any appreciable degree exhaust the plants for successional cropping. When, however, the fruits are allowed to develop, and the fruit stalk to become hard, the production of fresh fruits is quickly brought to an end.

Marketing.—The earliest marrows are usually wrapped in rhubarb or cabbage leaves, and packed between layers of paper in half-bushel hampers or half pots holding about one and a half dozen. Later, when prices fall, about a dozen marrows are put up in a bushel hamper or pot and covered with pea haulm or straw, or about three or four dozen are marketed in a cabbage crate. They are also carried loose in market vans or lorries direct to markets or retail shops, but this is a practice not to be recommended as it leads to much damage from the constant handling necessitated.

PESTS AND DISEASES OF THE VEGETABLE MARROW.

Root Knot Disease.—The pest causing this disease is among the worst that the cucumber, melon and tomato grower has to contend against. Marrows grown under glass are no less susceptible. The disease is caused by an eelworm (*Heterodera radicicola*), which burrows into the roots and causes minute warts or nodules on the rootlets, ranging from the size of a pin's head to that of a pea. Under the influence of the eelworms the root system eventually breaks down with the consequent destruction of the plants. A female eelworm is capable of laying 500 eggs, and as there are many generations in a year, the multiplication of the pest is rapid. The young worms are able to move through the soil, but only very slowly, and the spread of the pest from one bed to another is caused entirely by the transfer of contaminated material.

Control.—Chemicals applied to affected soil have no lasting effect, and where practicable the best measure to employ is to move all the soil to a good depth from the pits, treat the

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brickwork with hot lime-wash, and bring in fresh soil. Where suitable plant exists the soil may be satisfactorily sterilised by hot steam under high pressure, or—where the soil to be treated is not large in quantity and is spread thinly—considerable effect may be obtained by the use of boiling water at the rate of 7 gallons to the cubic foot.*

Slugs and Woodlice.—These pests, especially woodlice, frequently give trouble when manure from old spent hotbeds is used. Both are destructive to young plants and small fruits. Dusting round the plants with soot has the effect of deterring the pests from feeding on the plants. Dry Bordeaux mixture might also be used, it would prove more deterrent and the effect would last longer. The pests themselves may be trapped by means of pieces of potato, carrot or beet, placed under boards or slates. The traps should be examined at fairly frequent intervals and the animals destroyed.†

Wireworms.—Wireworms are often troublesome when marrows are grown in grassland which has been recently broken up. These insects may be very successfully trapped by means of potatoes buried just under the surface of the soil, each potato may have a stick pushed through it in order to mark its position, and to serve as a handle for lifting it when it is desired to examine it.

Red Spider and Thrips.—These pests not infrequently make their appearance if the atmosphere and the soil are allowed to become too dry. Consequently the best preventive, and even remedy if the attack is not too bad, is the judicious application of water to the soil, foliage, etc. Care should be taken that the water is at the same temperature as the house containing the plants.‡

Powdery Mildew.—Fungus diseases of marrows grown in the open are fortunately comparatively rare. The commonest is that caused by a powdery mildew (*Erysiphe cichoracearum*, D.C.), which not infrequently appears towards the end of the season when the fruiting period is almost completed. In certain seasons, however, it appears during the earlier part of the summer, especially when a period of damp weather follows one of dry heat, and it sometimes occurs on quite young plants.

* For information on the chemical treatment of soil see Robson, *Jour. Roy Hort. Soc.*, May, 1919, Vol. 44, p. 31

† For treatment in greater detail see "Woodlice in Glasshouses," by E. R. Speyer, this *Journal*, Feb., 1924, p. 1042.

‡ For chemical treatment of a severe infestation see Speyer, *Nature*, 7th June and 9th Aug., 1924.

The leaves and younger portions of the stem become more or less covered with a white powdery growth which, under the conditions mentioned, spreads rapidly and may do considerable harm to the plant, or even kill it outright.

If the mildew does not appear until August it is perhaps scarcely worth while attempting to control its spread, but the diseased plants should be destroyed by burning. When it occurs during the earlier summer months, however, it should be dealt with immediately. Badly infected plants should be uprooted and burned, whilst those less seriously affected should be sprayed thoroughly with a solution of potassium sulphide (liver of sulphur), 1 oz. to 3 gallons of soft water. Dusting the plants with flowers of sulphur when they are damp is also an effective method of checking the disease.

Some of the diseases of melons and cucumbers under glass are also capable of attacking marrows when the latter are grown in frames or pits. Amongst them the two following may be mentioned :—

Leaf Spot (*Cercospora melonis*, Cke.).—This disease first appears as small pale green spots on the upper surfaces of the leaves. Later the spots increase in size and, finally, irregular patches of a grey or brownish colour are produced, the leaves frequently withering very rapidly.

All diseased leaves should be gathered at once and burned. In severe cases it is advisable to spray with a solution of liver of sulphur (1 oz. in 3 gallons of soft water) to which $1\frac{1}{2}$ oz. of previously prepared and boiled flour paste have been added to facilitate wetting and adhesion. A buoyant atmosphere should be maintained round the plants by judicious ventilation. Watering should be done with discretion, and heavy dressings of stimulating fertilisers should be avoided.

Anthracnose (*Colletotrichum oligochætum*, Cav.).*—In its early stages this disease also takes the form of small pale green spots on the foliage. These quickly enlarge and become round and dry. The centres of such spots usually assume a reddish colour, while the margins are more or less yellow and appear water-soaked. On them the parasitic fungus produces minute pustules in which myriads of spores are borne. Ultimately the leaves wither as the spots enlarge and unite. If not checked in the early stages the disease spreads to the leaf-stalks and young stems, causing considerable damage. The measures of

* See "Anthracnose of the Cucumber under Glass," by W. F. Bewley, this *Journal*, Aug., 1922, p. 469, and Sept., 1922, p. 558.

control recommended for Leaf Spot may also be used for Anthracnose. Uneven temperature and excessive dampness of the air should be guarded against, since these factors are highly favourable to the development and spread of the disease. Soil acidity should be corrected by the judicious application of lime.

Collar-rot.—Marrow stems sometimes rot off at their bases near soil level, or immediately behind the fruit. This is not a specific fungus disease and is usually attributed to careless watering with too cold water. If a number of drops of water remain near together on the stem, rotting usually sets in at such places. In watering marrows, it is desirable to avoid wetting the stems by applying the water at least six inches from their bases. Powdered charcoal and quicklime mixed in equal proportions and placed around the injured parts will prove of value.

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COUNCIL OF AGRICULTURE FOR FOR ENGLAND.

THE fifteenth meeting of the Council was held at the Middlesex Guildhall, Westminster, on Thursday, 19th March, 1925. Mr. James Donaldson (Oxon.) was unanimously elected as Chairman for the year 1925. A cordial vote of thanks was passed to the retiring Chairman, Mr. George Edwards, for his services during 1924.

Statement by the Minister of Agriculture..—The Minister of Agriculture (the Right Hon. Edward Wood, M.P.), made a statement dealing generally with the agricultural situation. He said that at the December meeting he had referred to the prospect as a more hopeful one, and this was still the case so far as figures showed. The index number of the prices of agricultural commodities was on the whole rising, and was now three or four points higher than November.

He then referred to the abortive Agricultural Conference and informed the Council that he had, in addition to asking the organisations originally invited to the Conference, invited the Royal Agricultural Society, the Central Chamber of Agriculture, the Surveyors' Institution and the Land Agents' Society—and he now invited the Council of Agriculture—to make proposals to him so that the Government might be in possession of the views of all, and thus be in a position to develop an agricultural policy which was likely to be continued in the future and secure the industry from the danger of sudden or sharp reversals of national policy.

With regard to the Beet Sugar (Subsidy) Bill, this measure would, he hoped, be in a position to receive the Royal Assent in time to be operative by the end of the month. The Government had done its part and he thought it was up to the factories and to farmers to do theirs. In saying that, he meant that it was up to the farmers to grow adequate supplies of beet to meet the factories' requirements. The factories had agreed on terms which, from the farmer's point of view, could not be regarded as anything but satisfactory. The further outlook was one for the farmer and the factory so to develop the industry that at the end of the ten-year period it could stand well upon its own feet without a subsidy.

The Agricultural Rates Bill, which had now been passed, continued the privileges of last year's Act to agriculture, and this meant a relief of nearly three millions a year to farmers' rates. He congratulated the new Agricultural Wages Committees on the progress which they had made.

The Minister also informed the Council of the terms of reference of a Departmental Committee which he proposed to set up, jointly with the Secretary for Scotland, on the subject of Unemployment Insurance for Agricultural Workers. The Council of Agriculture had proposed the appointment of this Departmental Committee and he would refer its report to the Council for their views upon it as soon as it was issued and before any other action was taken.

The Minister added, with regard to the Report approved at the last meeting of the Council on the subject of the conditions of seasonal employment on the land, urging the Ministry to take action for the improvement of the conditions of employment of women and children, that he had conferred with the Minister of Health, and it had been decided first of all to approach the question of conditions in the Kent hopfields. A revision of model by-laws dealing with sanitary conditions was being considered by the Ministry of Health, and he hoped to issue a circular to hop growers urging co-operation with local authorities for the purpose of securing a reasonable standard of decency and comfort for those engaged in the seasonal work of hop-picking. The Ministry's inspectors would collect further material as to actual facts and conditions in relation to seasonal employment with a view to further educating public opinion upon the subject.

The Rt. Hon. F. D. Acland moved a vote of thanks to the Minister for his statement and asked, in regard to the proposed Committee on Unemployment Insurance, whether it would be

asked to explore the question and set out a scheme, even though a majority of the Committee was not in favour of bringing agricultural labourers within the scope of unemployment insurance.

Mr. George Dallas seconded the vote of thanks and congratulated the Minister on his full statement, which he said reflected the confidence of the Minister and the industry in the Council.

Mr. R. A. Matthews (Hereford), *Colonel G. L. Courthope, M.P.* (East Sussex) and *Lady Mabel Smith* desired to associate themselves with the vote of thanks. *Colonel Courthope* remarked upon the fact that with regard to the conditions of seasonal employment in the hop-fields the people themselves were often the greatest obstacles to improvement in their conditions. *Lady Mabel Smith* hoped that what was being done for the Kent hop-fields would soon be extended to the fruit-picking fields, especially the new ones, as it was always easier to start with better conditions in new schemes than to improve old ones. She inquired also as to the position of seasonal workers under the National Health Insurance. *The Minister* promised that he would consider Mr. Acland's point in regard to the Unemployment Insurance Committee.

Supplies of Lime.—*Sir Daniel Hall* referred to the suggestion made at the last meeting of the Council that a report should be furnished by the Ministry as to the adequacy and suitability of the existing sources of supply of lime for agricultural purposes. Certain inquiries had been made and it did not appear that the difficulty in regard to lime was in the supply. The price and cost of transport were, however, real difficulties. In order to get over them, there was the Ministry's scheme by which farmers who formed themselves into agricultural credit societies could obtain loans for the purchase of lime. A leaflet had been issued on the scheme and widely distributed throughout the country. So far, although many inquiries had been made, no society had yet registered itself or applied for a loan. He hoped, however, that the scheme would bear fruit in the coming year. *Colonel Wheeler* (Salop) said that it would help the supply of lime if the small lime-kilns about the country could be reopened. *Sir Merrik Burrell* added, however, that there was a lack of skilled lime-burners.

Rural Housing.—*The Rt. Hon. F. D. Acland* moved on behalf of the Standing Committee that its report on the question of the shortage of houses in rural districts be adoped. The report recommended that the Council should urge upon the Ministry of Agriculture the necessity of securing immediate action by the

Government to provide a large number of houses suitable for agricultural workers in rural districts as a national social question of first-class urgency and importance. He thought that rural housing tended to fall between the Chamberlain Act and the Wheatley Act. He hoped that the Government would carefully consider the principles of a Bill to be presented by Sir Alfred Knox and others. *Mr. J. T. Briggs* (Peterborough) referred to the Government's wish for a further million acres, if possible, to be brought under arable cultivation, and said that the lack of houses made it out of the question to get the necessary labour to do anything of that sort. There was a lack of sympathy and help from the Ministry of Health and the local authorities. Ever since December he had been trying to get some small assistance to build three houses on a farm of 300 acres, which had but one cottage, and he was no nearer success to-day than at the beginning. *Colonel Courthope, M.P.*, said that there was a definition of an "agricultural parish," under the existing regulations, which ruled out practically every parish which contained a villa or any residence beyond the doctor's and the squire's houses. He was told that there were hardly any rural parishes for the purposes of the Wheatley Act in the Home Counties. He would ask the Minister of Agriculture to urge the Minister of Health to exercise his discretion to prevent the ruling out, in this way, of parishes which were really agricultural. There were many rural cottages with three bedrooms, the present occupants of which—old couples or widows—only wanted two, so that it might help if two-bedroomed cottages were built for their accommodation and the larger cottages made available for the larger families. *Brig.-General Clifton Brown, M.P.* (West Sussex), said that there were thousands of cottages which ought to be occupied by agricultural labourers which were being occupied by the employees of county councils, railway companies, etc. He hoped the Ministry would ask the Minister of Health to circularise those bodies suggesting that they should find new cottages for their employees. *Mr. C. P. Hall* (Bedford) agreed with General Clifton Brown that it was the first duty of those public authorities which were pushing forward housing schemes to house their own employees. *Mr. John Beard* said that no scheme was likely to be a success if crowded with conditions, and if it attempted to fit houses to men who could not afford to rent them. A subsidy was necessary, and houses built for landworkers must be retained for them. At present, townsmen were buying cottages, or renting them furnished, as week-

end residences. Any man settled in a parish ought to be given a piece of land if he undertook to build a house upon it. With the increase in the value of land, the rent of houses would soon be put beyond the reach of agricultural workers unless safeguards were employed. If disused brickyards, old lime-kilns, and small stone quarries could be brought into commission again, housing in rural districts might be aided and a subsidy for these purposes would be worth while. Frequently, there was good brick clay in rural districts, but instead of making bricks there, they were brought at great expense from Peterborough. *Mr. Geo. Dallas* said that the question ought not to be a Party question, or even a controversial one amongst agriculturists. There was no question but that young agricultural workers were being driven away from the villages altogether. They got married and settled down in the only place where they could get a home, namely, in the town. *Mr. T. W. Atkinson* (Kesteven) said that his rural district council had recently built 72 houses and let them to agricultural workers. Rural district councils required to be reminded of their duty.

The Minister of Agriculture said that he had given this question very careful consideration for years past, but did not take so gloomy a view of it as Mr. Beard did. He had been in consultation with the Ministry of Health recently on the question and was assured that that Minister was very fully alive to its importance. *Sir Walter Berry* said that his experience was that townspeople were prepared to give double or treble as much as the agricultural labourer could pay in rent for rural cottages. *Mr. R. G. Patterson* (Staffs) said that in two villages near his farm nearly all the cottages were occupied by farm workers when he went there first. Now, the only cottages so occupied were tied cottages. Were it not for these, he could not continue his farm. There was a great demand for houses in the country from town workers, and, if no restrictions were put on the occupancy of cottages, no matter how many they built the question of rural housing for agricultural labourers would not be solved. *Mr. Haman Porter* said the land did not pay and it seemed of little use to encourage workers to settle on the land. *Mr. H. C. Gardner* (Worcester) said that the County Council had only this week passed a resolution to inquire into the manner in which his district council was doing its duty in regard to the supply of cottages. *Major Fawkes* (West Riding) said he did not think townsmen should be kept from living in the country. He would like the report referred back to the Standing Committee for

further consideration, and for a recommendation of definite action to be taken to the Council at its next meeting. *Mr. R. C. Grey* (Hunts) said that the rural district councils in his county were heartily sick of the whole question. The houses put up cost them about £900 and certain expenditure on them was being disallowed and rural district councils surcharged with it. The County Council had built 50 or 60 houses for their own employees. About a third of them only were being occupied by them. There was no housing question in his district, and, were it not for the fact that people came from urban districts to rent cottages, a number would be empty. *Mr. Acland* said that the Standing Committee would, if it were the Council's wish, certainly explore the matter further, though he thought that that should be done altogether apart from asking the Council to adopt the present Report. *Major Fawkes'* suggested amendment was then withdrawn and the Report adopted.

Small Holdings Legislation.—*The Chairman of the Standing Committee* (Mr. Acland) moved the adoption of a report which recommended that the Council should urge upon the Government—

1. To take steps to obtain a full and complete settlement of the financial position in regard to statutory small holdings by the date appointed—1st April, 1926.
2. To make a comprehensive small holdings scheme one of the main measures of their legislation programme of 1926.
3. To publish the principles on which such a scheme would be based this year, so that it may be properly considered by all concerned, with a view to facilitating its early passing into law, and its successful administration when passed.

Sir Douglas Newton, M.P. (Cambs.), said that the question of the settlement was receiving the closest attention of the County Councils Association, and he thought that a satisfactory settlement would be made. The Report made no mention of allotments, and he suggested that the Minister might be asked to take steps to encourage and promote the development of allotments so as to provide security of tenure so far as practicable and compensation for disturbance. *Colonel Abel Smith* (Herts) said that with regard to (1) of the recommendations it was not, in his opinion, in the interests of the small holdings movement that the settlement should now be pressed in view of the very unstable state of agriculture. No one could say what the economic position of small holders would be in the future. He moved, therefore, that recommendation (1) be referred back to the Standing Committee for further consideration. *Mr. Geo. Edwards* seconded this amendment. *Alderman Quinney* (Birm-

ingham) spoke in favour of allotments legislation. *The Chairman* pointed out that the Report before the meeting dealt only with small holdings. *Mr. Acland* added that the Standing Committee would look into the question of allotments legislation as a separate subject, and bring it before the Council at the next meeting. Recommendation (1) was fundamental to the position which the Standing Committee had taken up. *Mr. H. W. Thomas* (Hants), *Mr. J. S. Gibbons* (Gloucester) and *Mr. R. G. Patterson* spoke against the postponement of the settlement. The amendment was put to the meeting and lost, and the original motion to adopt the Report carried.

Election to Standing Committee.—*Mr. R. G. Patterson* moved and *Mr. McCraken* seconded the election of *Mr. Clement Smith* (East Suffolk) to the Standing Committee of the Council in place of the Chairman, who became a member of the body *ex-officio*.

CONTACT BETWEEN THE COUNCIL AND THE AGRICULTURAL COMMITTEE.—*Mr. Acland* moved the adoption of the Report made by the Standing Committee on this question. It recommended that representatives appointed by Agricultural Committees should keep their Committees in touch with the work of the Council, both by furnishing reports and agenda showing intended action, where possible, and by personal reports on action taken by Council meetings. Wherever such representatives desired that copies of agenda, reports and minutes should be sent to the Secretary of their Agricultural Committee, the Secretary of the Council would send them on request by such representatives. *Mr. A. Matthews* (Hereford) spoke in favour of the recommendation, and *Mr. A. Bath* said that Agricultural Committees ought to be in possession of the details of the Council's proceedings before questions were discussed. A report of each meeting ought, he thought, also to be sent to each Agricultural Committee and placed upon the agenda for discussion. *Mr. R. W. Hall* (Hereford) said he had been much impressed by the way in which the Council transacted its business, and he thought that reports from it should be brought before Agricultural Committees. He supported the recommendation. The Report was adopted.

REPORTS OF AGRICULTURAL ADVISORY COMMITTEE.—*Mr. Acland* moved the adoption of a Report from the Standing Committee recommending that "as the reports of the Agricultural Advisory Committee are furnished for the information of the Council and as it is desirable that notices of motion by members of the Council should be reached before the more formal business on the agenda, no change should be made in the order on the agenda as at present followed." The motion was seconded, and the Report adopted.

RATING OF SMALL HOLDINGS.—*Mr. Denton Woodhead* moved:—

"That the Council urges upon the Ministry of Agriculture and County Small Holdings Committees the desirability of render-

ing every assistance in their power to any small holders whose assessment for rating purposes is on a higher level than that of occupiers of neighbouring land, with a view to objections being lodged on the ground of unfairness."

Capt. E. T. Morris (Herts) seconded the motion and said he thought it would be very useful if the Ministry gave instructions to its Inspectors to go into the question in order that appeals might be made and substantial reductions secured in the burden of rating which small holders were bearing. *Mr. R. W. Hall* supported the resolution. In Herefordshire the Chief Agricultural Officer was instructed to appear before the Assessment Committee and do all that was possible to obtain relief. *Mr. A. Bath* said that in Middlesex, the County Land Agent had taken up the question of rating for small holders. *Mr. H. E. S. Upcher* (Norfolk) and *Mr. R. G. Patterson* also spoke in favour of the resolution, which was put to the meeting and unanimously adopted.

DOUBLE-DIPPING FOR SHEEP SCAB.—*Mr. R. W. Hall* moved:—

"That the necessity for a unanimous double-dipping Order for the eradication of sheep scab be urged upon the Ministry of Agriculture."

He said that there appeared to be no doubt that double-dipping of sheep was essential to the eradication of sheep scab. *Col. Wheeler* seconded the motion, which was supported by *Mr. A. Matthews* and *Mr. H. Dent-Brocklehurst* (Gloucester), who said that his county had joined with nine or ten other counties in making an Order that no sheep should come into the clean area unless they had been double-dipped twice in 14 days, once just before coming into the area and once four days after arrival. *Mr. Clement Smith* (East Suffolk) said that he was sure his county would strongly oppose a compulsory double-dipping Order for clean counties. He moved an amendment:—

"That a double-dipping Order for the eradication of sheep scab be urged upon the Ministry of Agriculture for those counties where the disease exists."

The amendment was seconded by *Mr. Owen Webb* (Cambridge) and supported by *Mr. W. H. Thomas.*

Lord Bledisloe, Parliamentary Secretary to the Ministry of Agriculture, said that the whole question was at present under the serious consideration of the Ministry and that it would be easier in another month or so to say what the future policy in regard to sheep scab was likely to be. At present, the practice was that double-dipping within 14 days was insisted upon in the bad areas. *The Chairman* then suggested that in view of this statement it would probably be better to stand the matter over for the present. He therefore suggested that the mover and seconder might agree to withdraw the motion until the next meeting, when in all probability some definite step could be announced. This was agreed and the motion withdrawn.

SURPLUSES IN NATIONAL HEALTH INSURANCE.—*Mr. Denton Woodhead* moved:—

"That the Council should make representations to the Royal Commission on National Health Insurance showing the great injustice that would be inflicted on the agricultural industry, both employers and employed, if a system of pooling the surpluses of Approved Societies administering National Health Insurance were adopted."

Capt. E. T. Morris seconded the motion, which was supported by *Alderman Thomas Davies* (Durham) and *Mr. Christopher Turnor*, and carried unanimously.

GUARANTEES FOR WHEAT.—*Mr. H. W. Thomas* moved:—

"That in the national interest the cultivation of wheat should be encouraged by the Government guaranteeing the cost of production to the producer."

Mr. Thomas said that he had withdrawn a similar resolution at the last meeting of the Council in view of the expected meeting of the Agricultural Conference which, however, had not taken place. Only 20 per cent. of the flour used in this country was made from home-grown wheat, and the percentage might, he thought, well be increased to 40. The Agricultural Wages Act had substantially increased the cost of corn production. He wished, however, to speak from the standpoint of the national interest. He considered guarantees justifiable as a form of national insurance. *The Chairman* drew the Council's attention to the fact that it had been invited that morning by the Minister to contribute to the body of suggestions towards a suitable agricultural policy. He did not know how far the carrying of the present motion might take the Council, and how far it might prejudice its freedom in making suggestions. He would therefore ask Mr. Thomas to withdraw his motion and leave the suggestion with the Standing Committee. *Mr. Thomas* agreed to this course on the understanding that the Standing Committee would take up the question.

REPORT OF AGRICULTURAL ADVISORY COMMITTEE.—*Mr. Dallas* moved that the Report (No. 9) of the proceedings of the Agricultural Advisory Committee for England and Wales be received. The motion was duly seconded. *Mr. C. P. Hall* supported it, but regretted that the Report contained no reference to land drainage. He wished to move an amendment in these terms:—

"That this Council requests the Agricultural Advisory Committee to consider the question of land drainage as being of the first and most urgent importance in connection with any proposal making for increased production."

Mr. Dallas suggested that the amendment was really a recommendation to the Advisory Committee, and need not be moved as an amendment. *Mr. Hall* agreed, and *Lord Bledisloe* said that the Ministry welcomed items appearing on the agenda of the Agricultural Advisory Committee that are not put there by the Ministry. The Ministry realised the immense importance and urgency of land drainage, and had, in fact, a Bill under consideration which the County Councils Association were considering, with the object of giving county councils much larger powers than in the past over drainage areas within their administrative districts. The original motion to receive the Report was then put to the meeting and carried.

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AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

REPORT (No. 9) to the Councils of Agriculture for England and Wales on the Proceedings of the Agricultural Advisory Committee:—This report contains a note of the proceedings of three meetings, namely, those on 1st October, and 10th December, 1924, and 4th February, 1925. The first of these three meetings was held whilst Mr. Noel Buxton was Minister.

(1) **Foot-and-Mouth Disease.**—At the first of the meetings, the Ministry's Chief Veterinary Officer reported that the position had become much more favourable There were in England six areas only then under control, namely, in Nottingham, Lincoln, Northampton, Oxford, Wiltshire and Essex. In Scotland, there had been no outbreaks for 3 months, and representations were being made for the reduction of the 28 day period for detention of Irish store cattle on farms in Scotland to 6 days' detention, which was the period prescribed before the present recrudescence of disease. The Committee was asked to advise whether a return should not now be made to the requirement of the 6 day period so far as Scotland was concerned. The Committee agreed that it should be so, subject to a provision that if there were any deliberate attempt on the part of dealers to bring Irish cattle through Scotland with this short period into England, the Ministry ought immediately to reconsider the whole position. The question of Local Authorities' regulations restricting the movement of animals into their areas was once more considered, but it was decided to postpone it pending the report of Mr. Pretyman's Committee on Foot-and-Mouth Disease. The Committee also considered the question of penalties in prosecutions for the illegal movement of animals in contravention of Foot-and-Mouth Disease Orders. The Committee agreed that whilst the fine per head might prove a sufficient deterrent to contraventions where a number of animals was involved, it might not do so where only one or two, or a few, animals were involved. To remedy, this, and as the offence was the same whether one or a number of animals was moved, it recommended that the Ministry should examine the position and see whether it was not possible to prescribe a large maximum fine for the offence

irrespective of the number of animals whilst retaining the power to inflict a heavy penalty on the illegal movement of a large consignment.

(2) **Agricultural Co-operation and Credit.**—It was reported to the Committee that the Agricultural Organisation Society had been dissolved and that the National Farmers' Union had agreed to take over a substantial part of the work hitherto done by them. This the Ministry regarded as a hopeful sign that increased progress in the movement would be attained. The Advisory Committee on Credit and Co-operation had dealt with a number of applications for loans out of the funds which had been made available by the Government for co-operative enterprise started by farmers. These applications were from 9 societies for loans of £50,000. In 5 of the cases loans had been recommended to the total of about £12,000; in the other cases the Committee had not been able to recommend the loans asked for. The Ministry was pressing forward the work of investigation into marketing problems with a view to better advice than hitherto being available.

(3) **Liming of Land.**—It was reported that facilities under the Agricultural Credits Act, 1923, to assist farmers to obtain loans for the liming of land were available provided societies were formed, or existing societies used for the purpose. The Ministry was anxious to assist liming wherever it was required.

(4) **Proposed Conference on Agricultural Policy.**—At the meeting on 10th December, the Minister informed the Committee of the action which the Government had taken in regard to the proposed Conference. At the meeting on 4th February the Minister informed the Committee that the Workers' Union had now intimated that in their view no useful purpose would be served by their appointing representatives to the Conference as requested. As was generally known, the National Union of Agricultural Workers had decided some time earlier not to appoint representatives.

(5) **Re-introduction of Tuberculosis Order.**—The Minister consulted the Committee in regard to the proposal to re-introduce the Tuberculosis Order with the Milk and Dairies Act next September. The Committee agreed in general principle to the proposal, though the question was reserved for further consideration in detail when plans should be more mature.

(6) **Suggested Register of Movement of Live Stock.**—The Committee considered the following request which the Ministry had received from the National Farmers' Union: "In order to facilitate the operation of the Ministry's policy in foot-and-mouth disease to ask the Minister of Agriculture to issue an Order requiring all owners of live stock to maintain a register showing all movements of stock under their control." It was agreed that the matter should be looked into, and the Ministry undertook to prepare a draft Order for preliminary consideration with the recommendation which it was understood the Pretyman Committee were making on the point.

(7) **Sheep Scab Policy.**—The Committee considered a memorandum dealing with the preliminary step in revising the general Sheep Scab policy of the Ministry. It dealt with the withdrawal of "single dipping" regulations. The Committee concurred in the proposal that all single dipping regulations should be withdrawn.

(8) **Reports of other Departmental and Advisory Committees.**—Two reports of the proceedings of other Committees have been received by the Committee. *(20th February, 1925.)*

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APRIL ON THE FARM.

J. R. Bond, M.Sc., M.B.E., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Seasonal Operations.—April is one of the busiest months of the farm year. This season the first duty will probably be to complete the sowing of spring corn, for until the middle of March little land other than light soils came into drillable condition, and considerable areas had been unfit to plough. Late-sown oats are always the most badly "fritted," but the frit fly does more damage in some years than in others. It was very bad in Derbyshire in 1922. During that year, when a wet spring was followed by dry weather in May and June, I observed a badly attacked field and an excellent piece of oats over the hedge, although both had been sown late. The latter land was in high condition and the farmer practised heavy seeding, 8 bushels per acre. I believe that heavy seeding is desirable as a safeguard against frit damage when drilling in April. Malting barley should also be drilled at heavy rates when put in late, as in this case tillering is undesirable: late tillers make an uneven sample.

Another urgent matter is the manuring of meadows, followed by chain harrowing and stone picking. Attention will next be given to cultivations preparatory to drilling mangolds and marrow stem kale, which should be in the ground by the end of the month, and to potato planting. Winter corn not yet harrowed should have this attention, and the nitrogenous top dressings intended for weak crops should be applied without delay. Towards the end of the month grass and clover seeds will be sown in the more forward pieces of spring corn, earlier sowing being desirable, however, when the nurse-crop is wheat. It is a good rule to apply slag when seeding down, whether for long or for short leys, as undoubtedly slag assists towards the establishment of a good clover plant.

Many farmers are still unaware of the important results of recent experiments on methods of sowing grass and clover seeds*; the land should be well but not deeply harrowed before sowing and, if the seed is broadcast, it should be *covered* by harrowing-in with a light harrow. Rolling may be necessary on light soils, but the harrowing-in must not be omitted. Recently a Derbyshire farmer told me that during sixteen years when he had the use of a clover seed drill he never had a missed plant; but that while farming another holding with a smaller acreage of arable land, which hardly justified the possession of a drill, he had found difficulty in obtaining a satisfactory take. There may be other factors contributing to the difficulty in this case, but the value of drilling is emphasised by farmers who have tried this method. With a suitable seed barrel, a cup-feed corn drill may be used, the coulter weights being taken off to prevent too deep penetration.

Charlock seedlings begin to appear in April, and where powdered kainit is to be tried as a means of destruction, it should be applied whilst the plant is in the rough-leaf stage. On land likely to be infested, deep drilling of a late-sown barley crop followed by chain harrowing is an effective means of keeping the weed down. The charlock germinates before the barley, and may be dealt with about a week before the barley blade appears. Deep harrowing would bring up further supplies of charlock seeds and disturb the barley too much.

Moisture.—In spite of the heavy rainfall of the past winter and the consequent wetness of the land, it is necessary to conserve moisture during the cultivations in preparation for root sowing. Soils and subsoils possess only a limited capacity for

*See this *Journal*, Vol. XXIX, pp. 53, 132, 1125 and Vol. XXX, p. 1134.

moisture, and root crops in particular require larger quantities of water than ordinarily reach the roots in the form of summer rain. Pending the main tillage operations, the entire green-crop area should be kept mulched with a surface layer of loose dry soil, under which the soil will dry more steadily and with less tendency to clod formation. Chain harrowing will produce the desired effect, and land so treated will more readily work down to a tilth than it would if left to dry and bake in lumps until the time for final preparation. The crust that sometimes forms when heavy rains follow surface tillage need not be feared, as it is easily reduced by further light harrowing.

The work of tilth formation is best carried out by preparing the land in successive strips, stirring, refining, ridging up, manuring and covering the manure on one strip before proceeding with the next piece of the field. The required depth of mould should be secured by successive operations of gradually increasing penetration.

Last spring I had under particular observation two fields that were being prepared for roots. In one case the land was manured and ploughed during the winter, and in March it received a superficial preliminary stirring. About the end of the month it was gradually refined from the surface downwards with the spring-tooth harrow, then drawn up in ridges to settle; these were later dressed with the chain harrows before sowing with mangolds. The seed came well and the crop, which was liberally fertilised, yielded over 40 tons per acre. In the other case, the spring workings did not begin until April and the first operation was a deep cultivation, which brought up large lumps of damp soil: these baked into clods, which many further workings, aided by dropping weather in May, ultimately reduced to a tilth. The land was ridged up, manured and sown with swedes in May. The swede crop succeeded, yielding about 25 tons per acre, the result being favoured by a wet summer. In a dry May, the plant might have been taken by the fly; but the most obvious result of the error of cultivating deeply at the start was the greatly increased labour of reducing clods, which, as the land was clean, need not have been allowed to form.

Tilth.—In the preparation of land for a root crop, the soil is ordinarily reduced to a loose incoherent and comparatively dry mass of particles and groups of particles. This condition is necessary to allow of the extraction of twitch, the incorporation of fertilisers, and the covering of the seed with an appropriate

depth of fine soil. Refining the soil also aerates it and thereby stimulates bacterial activity. A loose incoherent mass is not, however, a favourable rooting ground for crop plants: the best conditions are not attained until the mass of soil has regained a reasonable amount of coherence, having settled and become moist. The necessary moisture rises from the subsoil.

Potatoes are capable of commencing growth in a tilth that is comparatively dry and loose, as the reserve of moisture in the seed may be drawn upon until the soil has become sufficiently settled and moist. Mangolds, however, germinate and come away badly when drilled on such a seed bed. If the land is clean and has been manured and ploughed in good time, the spring preparations for sowing on the flat may be comparatively simple and shallow. It is, in fact, a considerable disadvantage to attempt to break up the land and reduce it to a tilth. This year, many acres will necessarily be manured in the ridge, and seed will be drilled on ridges that have not had the time necessary for them to become settled and moist before sowing. In this case the assistance of the ridge roller will be valuable. Where the ridges can be manured and split a fortnight before sowing, however, it is good practice to dress them with the chain harrows to remove the clods from the tops of the ridges—where they would be a nuisance at singling time—and to expose the moist and somewhat firm soil in which the mangold seed will germinate well.

Weeds.—Annual weeds in land intended for roots can be considerably reduced by ridging up and chain harrowing before drilling. The presence of twitch (*Agrostis*), however, complicates the method of preparing the seed bed. On heavy soils it is almost impossible to give infested land a thorough spring cleaning without incurring considerable risk of a reduced mangold crop. Bare fallowing is the favourite method of dealing with this pest, during which series of operations the soil is best kept in rough dry clod until after midsummer. In a wet season such as that of 1924, however, even bare fallowing may fail to clean the land. During the later stages of the war when so much land was in foul condition, many farmers attempted bare fallowing who had little experience of the method, and in some cases the final result was a piece of land in worse condition than it would have been if it had grown a crop of corn.

Twitch is kept down by growing heavy corn crops. During 1919, I observed a good illustration of this principle. A farmer who had about 50 acres of his arable land in such a state as

appeared to necessitate bare fallowing did fallow 40 acres; but in one field, which was as foul as the rest, he decided to try a different plan. During April he skimmed the twitchy layer off, worked it about with tine implements until it was somewhat dry, then ploughed it down under a fairly deep furrow. He then applied a heavy dressing of artificial manures and drilled the field thickly with barley. The barley came up quickly and made a dense cover before the twitch revived. The stubble was found to be remarkably free from the weed. In this case the soil was of fairly strong texture, but I have seen the method adopted with success on light land. Docks apparently cannot be smothered; but Mr. J. C. Brown states that he has been able to suppress thistles by growing two smother crops in succession.

Live Stock.—Milk producers contend that in April cows require heavier feeding than in other months to produce the same quantity of milk. There appears to be no experimental evidence in support of this contention, but it is not here disputed. Generally the supplies of succulent food have become rather short, roots have lost some of their digestible contents, and the effects of minor omissions from the diet, such as salt, and mineral deficiencies in the fodder, will have more influence at the end of the winter than at the beginning. Moreover, housed cattle which receive little attention in the matter of grooming often become very uncomfortable owing to skin and hair affections at this time of the year. Cows that have been rather warmly housed during the winter should be gradually hardened during April in anticipation of grass day next month.

While cattle are still indoors the opportunity should be taken to dress their backs to destroy warbles. There are several dressings which if properly applied will kill 80 per cent. or more of the maggots. One that has been very thoroughly tested and found to be both effective against the warble and harmless to the cattle may be prepared by mixing 1 lb. of fresh lime in a gallon of water, adding 4 lb. of tobacco powder, stirring and after standing for 24 hours straining the clear liquid through a cloth. The wash deteriorates on keeping.

April is the month in which the new grazing season begins. Feeding pastures are stocked with large bullocks, dry cows or smaller heifers, according to the known qualities of the respective fields. Dry cows and young cattle other than calves begin to lie out on the second quality pastures during this month, the best dairy pastures being reserved to produce a full bite for the milkers when they begin to lie out in May. Before the

cattle go out the hedges or walls and gates are again looked over and repaired where necessary. Rough old hedges are admittedly best pleached in April while the sap is rising; but the policy of deferring hedge cutting until this month is generally associated with procrastination. Neglected fences are too common a feature of the British countryside, excepting in districts where farming opinion has been cultivated by the activities of local hedge-cutting associations. Some of these societies have accomplished most valuable results.

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MANURES FOR APRIL.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

Manuring of Swedes.—The question whether swedes require artificial fertilisers as well as farmyard manure was recently raised at a farmers' meeting. This problem has been made the subject of many field experiments in different parts of the country, and the general result has been that either artificials alone or farmyard manure alone suffice to give crops up to 20 or 25 tons per acre, but a combination of the two gives better results where crops of 30 or 40 tons are obtainable. The growth of swedes is more frequently limited by climatic factors than by fertilisers. In the southern and midland counties, conditions rarely permit of the large crops obtainable in the north of England and in Scotland. In the South Country crops up to the limit of the water supply in the soil can be obtained by the use of some 10 to 12 tons of dung per acre, but only rarely can this be increased by the addition of artificials.

The past season at Rothamsted was very favourable to the growth of swedes, and without artificials the yield amounted to 24 tons per acre. When in addition a liberal dressing of artificials was supplied the yield was pushed up only to 26 or 28 tons according to the dressing; in less favourable years the increases have been smaller. In the numerous seasons in which we have experimented with swedes our crops have varied from 30 tons per acre downwards, but we have not as a rule been able to obtain important additions of crop in good seasons or to save the crop in bad seasons by the addition of artificials to farmyard manure.

A useful mixture of artificials for swedes in the southern and midland counties is composed of 1 cwt. sulphate of ammonia and 4 cwt. superphosphate applied with the seed: as an alternative 10 to 12 tons of dung can be used, but it is not necessary to use both. In the northern counties, where higher yields are obtainable, a combination of both may give good results.

Does Grazing Grass Respond Best to Slag or Bone?—This matter has been discussed a good deal, but unfortunately it is not possible to give a definite answer. In the Cockle Park experiments, slag gave the best results both on the lighter and heavier soils, but the land there is a poor Boulder Clay, very different in character from some of the better grass land of the midland counties. The subject is one as to which further tests might well be made.

Artificial Manures for Hay Land Usually Receiving Dung.—Among questions recently raised at a farmers' lecture was the following:—Could hay land which normally receives dung, be dressed with nitrate of soda alone in a year when no dung is available? No harm could result to hay land treated in this way. The disadvantages of applying nitrate of soda alone is that it furnishes neither phosphates nor potash, both of which are essential to the grass if the best results are to be obtained. Farmyard manure, however, contains a considerable quantity of potash, 10 tons supplying approximately as much as is present in 3 cwt. of muriate or sulphate of potash. Dung also contains phosphate, though as a rule not sufficient for the best development of the herbage. Good results can be expected from the occasional use of basic slag in autumn, followed by nitrate of soda in spring. If farmyard manure has not been given for some time, a dressing of kainit is commonly advantageous in supplying the needful potash and thus ensuring adequate development of the clover.

The Use of Nitrogenous Fertilisers on Pasture Land.—Considerable interest is being taken in the question whether sulphate of ammonia or nitrate of soda should be applied to grazing land. At present the only experimental evidence is that furnished by Cockle Park, and this is not direct evidence but is based on the feeding value of hay from mown land. It is there shown that sulphate of ammonia used alone increased the yield of hay from 19 to 23 cwt. per acre, but it depressed the value of the hay as shown by the feeding results from 80s. to 72s. per ton: the net result was a financial loss of 14s. 5d. per acre. A similar depression in money value was obtained when slag was given in addition.

Slag alone yielded 25¼ cwt. per acre, valued on the basis of feeding trials at 93s. per ton, while slag and sulphate of ammonia gave 29¾ cwt. per acre valued at 24s. per ton; the profit from the slag was 31s. per acre, and from the slag and sulphate of ammonia 17s. 2d. However, grass land differing from that at Cockle Park might well respond differently, and the subject is one on which more experiments are needed before an answer can be given.

Ploughing in of Green Crops.—An interesting result was obtained at Rothamsted last year showing the increased yield obtained by ploughing green crops into the soil before sowing cereals. Mustard had been grown in the late summer of 1923; the crop was ploughed in just before the sowing of oats in October; the yields of oats in August, 1924, were as follows:—

	Bushels per Acre.		
	No other Manure.	5 tons Town Refuse.	10 tons Town Refuse.
Green Manure (Mustard) ...	43.3	51.8	48.8
No Green Manure ...	27.5	29.3	32.8
Balance in favour of Green Manuring	15.8	22.5	16.0

There was thus an increase of 16 bushels obtained in two tests, and 22½ bushels in the third as the result of ploughing in the green crop. The cost of the green crop is not great, and its effect is very striking: a dressing of farmyard manure could hardly have been expected to do better. It is rarely possible to treat much land in this way, but no opportunity should be neglected. Mustard is nearly always suitable: vetches are good in a heavy soil but not in a light one.

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MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
Animal Nutrition Institute, Cambridge University.

The Purchase of Feeding Stuffs for Milk Production.—In constructing a balanced ration for feeding dairy cows, the home-grown feeding stuffs generally supply all the carbohydrates or fats required, but the protein supply is generally deficient. The main reason why the dairy farmer purchases feeding stuffs is to obtain the extra protein the animal requires for milk production, and he therefore requires to know, not simply how much starch equivalent they supply, but how much digestible protein they supply and its relative cost. In order to enable the dairy farmer to compare the relative values of foods from a

DESCRIPTION.	Price per Qr.		Price per Ton.	Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb Starch Equiv.	Per cent of Digest. Crude Protein
	s. d.	lb.	.	£ s.	£ s.		s.	d.	%
Wheat, British	—	—	13 13	0 16	12 17	71·6	3/7	1·92	10·2
Barley, British Feeding	—	—	10 15	0 12	10 3	71	2/10	1·52	6·5
„ Canadian :—									
No. 3 Western	41/9	400	11 13	0 12	11 1	71	3/1	1·65	6·5
„ 4 „	40/9	„	11 8	0 12	10 16	71	3/1	1·65	6·5
„ American	40/9	„	11 8	0 12	10 16	71	3/1	1·65	6·5
„ Danubian	40/9	„	11 8	0 12	10 16	71	3/1	1·65	6·5
„ Karachi	41/0	„	11 10*	0 12	10 18	71	3/1	1·65	6·5
Oats, English, White	—	—	10 0	0 13	9 7	59·5	3/2	1·70	8·0
„ „ Black and Grey	—	—	9 13	0 13	9 0	59·5	3/0	1·61	8·0
„ Scotch White	—	—	11 0	0 13	10 7	59·5	3/6	1·87	8·0
„ Canadian :—									
No. 2 Western	35/3	320	12 7	0 13	11 14	59·5	3/11	2·10	8·0
Argentine	29/0	„	10 3	0 13	9 10	59·5	3/2	1·70	8·0
Maize, Argentine	42/6	480	9 18	0 13	9 5	81	2/3	1·20	7·1
Beans, English Winter	—	—	11 5	1 12	9 13	67	2/11	1·56	20·1
„ Chinese „	—	—	11 15	1 12	10 3	67	3/–	1·61	20·1
Peas, English Maple	—	—	11 7	1 8	9 19	69	2/11	1·56	19·4
„ Japanese	—	—	24 5†	1 8	22 17	69	6/7	3·53	19·4
Rye, Homegrown	—	—	11 0	0 16	10 4	71·6	2/10	1·52	9·6
Dari, Egyptian	—	—	10 17	0 15	10 2	75·2	2/8	1·43	7·7
„ Persian	—	—	12 10	0 15	11 15	75·2	3/2	1·70	7·7
Millers' Offals :—									
Bran, British	—	—	8 2	1 7	6 15	45	3/0	1·61	10·9
„ Broad	—	—	9 15	1 7	8 8	45	3/9	2·01	10·9
Middlings—									
Fine Imported	—	—	9 15	1 2	8 13	72	2/5	1·29	12·6
Coarse, British	—	—	8 5	1 2	7 3	64	2/3	1·20	11·5
Pollards, Imported	—	—	7 15	1 7	6 8	60	2/2	1·16	11·6
Meal, Barley	—	—	13 0	0 12	12 8	71	3/6	1·87	6·5
„ Maize	—	—	11 12	0 13	10 19	81	2/8	1·43	7·1
„ „ South African	—	—	10 12†	0 13	9 19	81	2/5	1·29	7·1
„ „ Germ	—	—	10 5	0 19	9 6	85·3	2/2	1·16	18·4
„ „ Gluten Feed	—	—	11 0	1 7	9 13	75·6	2/7	1·38	20·0
„ Locust Bean	—	—	9 15	0 9	9 6	71·4	2/7	1·38	4·0
„ Bean	—	—	13 5	1 12	11 13	67	3/6	1·87	20·1
„ Fish	—	—	21 0	4 7	16 13	53	6/3	3·35	50·0
Linseed	—	—	24 10	1 11	22 19	119	3/10	2·05	19·4
„ Cake, English 12°/. Oil	—	—	14 5	1 18	12 7	74	3/4	1·78	25·3
„ „ 10°/. Oil	—	—	13 10	1 18	11 12	74	3/2	1·70	25·3
„ „ 9°/. Oil	—	—	13 5	1 18	11 7	74	3/1	1·65	25·3
Soya Bean Cake 6 % Oil			12 0	2 14	9 6	69	2/8	1·43	38·2
Cottonseed Cake, English 5½°/. Oil	—	—	8 0	1 15	6	42	3/0	1·61	17·6
„ „ Egyptian 5½°/. Oil	—	—	7 12	1 15	5 17	42	2/9	1·47	17·6
Decorticated Cotton Seed Meal 7% Oil	—	—	12 0	2 14	9 6	74	2/6	1·34	36·3
Ground Nut Cake 7% Oil	—	—	10 17*	1 16	9 1	56·8	3/2	1·70	42·0
Palm Kernel Cake 6°/. Oil	—	—	9 10‡	1 3	8 7	75	2/3	1·20	17·1
„ „ Meal 2°/. Oil	—	—	8 7	1 4	7 3	71·3	2/–	1·07	17·1
Feeding Treacle	—	—	7 10	0 8	7 2	51	2/9	1·47	1·1
Brewers' Grains :—									
Dried Ale	—	—	9 17	1 4	8 13	49	3/6	1·87	14·0
„ Porter	—	—	9 7	1 4	8 3	49	3/4	1·78	14·0
Wet Ale	—	—	1 12	0 9	1 3	15	1/6	0·80	4·8
„ Porter	—	—	1 7	0 9	0 18	15	1/2	0·62	4·8
Malt Culms	—	—	8 10†	1 14	6 16	43	3/2	1·70	19·9

* At Bristol. † At Liverpool. ‡ At Hull.

E.—The prices quoted above represent the average prices at which actual wholesale transactions have taken London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage lers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. rial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 75, the quivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar on will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the f such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own The manurial value per ton figures are calculated on the basis of the following unit prices :—N, 13s. ; P_2O_5, 4s. 2d. 6d.

protein-supplying standpoint, a new column has been included in the feeding stuffs table giving the percentage of digestible protein present in the feeding stuffs. By dividing the price per ton of the feeding stuffs by the percentage of digestible protein present, the farmer is enabled to ascertain in a rough and ready way the cheapest foods regarded as sources of supply of protein.

Milk Yield of Cows as Affected by Times of Milking.—Much discussion always arises when the subject of the advantages of frequent milking of cows is mentioned to dairy farmers. The general custom is to milk twice daily, but occasionally dairy farmers, particularly when dealing with heavy yielding cows, will milk three times a day or more. The advocates of frequent milking state that the total milk yield of the cows is increased materially by increasing the number of times of milking. An interesting study on this subject has been carried out at Missouri University by Ragsdale, Turner and Brody. In their experiments, which were extended over a period of three months, they used two Jersey and two Ayrshire cows. As the result of their observations, the conclusion arrived at was that a cow that is milked three times daily will give 110 per cent. of the milk that is given by the cow milked twice daily. If the number of times of milking is increased to four times a day, the yield will be increased to 116 per cent. Thus, on this basis, a cow giving 10 quarts of milk a day when milked twice daily will give 11 quarts if milked three times a day, and 11·6 quarts if milked four times a day. The results of this experiment indicate that where labour conditions can be adjusted to the new routine, milking three or even four times a day will be followed by beneficial results. In a herd giving 100 gallons of milk a day an extra 10 gallons a day is worth striving for.

The Influence of Fats in Feeding Stuffs.—In making up rations for animals, a point that is often overlooked is the amount of fat that is given in the ration. Experiments with adult ruminants showed that an increase of the fat beyond 1 lb. per 1,000 lb. live weight is likely to lead to disturbance of digestion, and the appetite also is likely to be affected. Rice bran is particularly rich in oil, samples often containing as much as 13-14 per cent. of fat, and care should always be exercised in rations including this material, to ensure that the maximum desirable amount of oil is not exceeded. With growing stock and young animals, and also with pigs, up to 2 lb. of fat per 1,000 lb. live weight can be given without any detrimental effect.

FARM VALUES.

CROPS.	Market Value per lb. S.E.	Value per unit S.E.	Starch Equivalent per 100 lb.	Food Value per Ton.	Manurial Value per Ton.	Value per Ton on Farm.
	d.	s. d.		£ s.	£ s.	£ s.
Wheat	1·20	2 3	71·6	8 1	0 16	8 17
Oats	1·20	2 3	59·5	6 14	0 13	7 7
Barley	1·20	2 3	71·0	8 0	0 12	8 12
Potatoes	1·20	2 3	18·0	2 1	0 4	2 5
Swedes	1·20	2 3	7·0	0 16	0 2	0 18
Mangolds	1·20	2 3	6·0	0 14	0 3	0 17
Beans	1·20	2 3	67·0	7 11	1 12	9 3
Milk			17·1			
Good Meadow Hay	1·87	3 6	31·0	5 8	0 14	6 2
Good Oat Straw	1·87	3 6	17·0	2 19	0 7	3 6
Good Clover Hay	1·87	3 6	32·0	5 12	1 0	6 12
Vetch and Oat Silage	1·52	2 10	14·0	2 0	0 7	2 7
Barley Straw	1·87	3 6	19·5	3 8	0 6	3 14
Wheat Straw	1·87	3 6	11·0	1 18	0 4	2 2
Bean Straw	1·87	3 6	19·0	3 6	0 9	3 15

* * * * * *

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending March 11th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	14. 0	13.17	13. 0	13. 9	17. 4
,, ,, Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	13.11*	13.11*	13.11*	13.11*	(N)13.1
,, ,, ,, neutral (N. 21.1 per cent.)	14.14*	14.14*	14.14*	14.14*	(N)13.11
French Kainit (Pot. 20 per cent.)	3.0	3. 0	...	2.12	2. 7
,, ,, (Pot. 14 per cent.)	2.15	2.15	2. 7	2. 7	3. 5
Potash Salts (Pot. 30 per cent.)	...	...	3.17	3.15	2. 6
,, ,, (Pot. 20 per cent.)	...	...	2.17	2.10	2. 6
Muriate of Potash (Pot. 50 per cent.) ...	8.5	7.10	7. 5	7. 0	2.10
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	11.10	11.10	4. 9
Basic Slag (T.P. 30 per cent.)	3. 2§	...	2.12§	2.12§	1. 9
,, ,, (T.P. 28 per cent.)	...	2. 1‡	...	2.10§	1.10
,, ,, (T.P. 26 per cent.)	...	1.14‡	...	2. 8§	1.10
,, ,, (T.P. 24 per cent.)	...	1.11‡	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 8	1.11
,, (S.P. 30 per cent.) ...	3. 7	3. 5	3. 8	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9.10	8.10	8.10	8. 5	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	7. 0†	7. 7†	6.10	6. 7†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	...	...	13. 0	...	...
,, ,, (N. 9, T.P. 10 per cent.) ..	...	...	...	12.10	...
Burnt Lump Lime	1. 8	1.17	1.18	2. 2§	...
Ground Lime	1.14	2. 7	2. 8	1.16§	...
Ground Limestone	1. 1	...	1. 4	1. 5§	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named, and at London are for not less than 4-ton lots. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

MISCELLANEOUS NOTES.

Clean Milk Competitions in the North of England.

Two clean milk competitions, each covering a wide area in the north of England, were held in 1924. One of them, covering the three Ridings of Yorkshire, was organised by the Yorkshire Agricultural Society in co-operation with the Yorkshire Council for Agricultural Education. The other was organised by Armstrong College, Newcastle-on-Tyne, in conjunction with the Local Education Authorities of the four counties concerned, viz., Cumberland. Durham, Northumberland and Westmorland.

Yorkshire Competition.—The Yorkshire competition, which attracted 18 entries, extended over a period of four months, commencing on 14th February and ending on 14th June, 1924, thus including two cold and two warmer months; and prior to its commencement, arrangements were made for two members of the University Staff to visit and advise competitors as to the methods necessary for clean milk production. Twelve competitors availed themselves of the offer.

The system of awarding marks was similar to that detailed in the Ministry's Guide* and included inspection on the farm and the examination of milk for bacteria, keeping qualities, and fat content. Eight samples of milk were taken from each competitor, seven samples of morning's milk being submitted by competitors themselves and one surprise sample of afternoon's milk being taken by the inspecting judge on the occasion of his official visit. Generally there was a very close agreement between the bacterial counts of the competitor's own samples, and that of the surprise sample. In regard to the testing of these samples it is of considerable interest to note that 5 competitors out of 18 had 100 per cent. of their samples within the standard laid down for Grade A milk, 4 competitors 87.5 per cent., 1 competitor 75 per cent., and 4 competitors 62.5 per cent. In addition, of the total samples submitted, 77.2 per cent. reached the standard required for Grade A milk, and the average sample kept perfectly sweet and untainted for 3½ days. These figures demonstrate that the competition was effective in educating the competitors in the meaning and value of clean methods.

A Challenge Cup provided by the Olympia Oil and Cake Co., Ltd. was awarded. This cup has to be won three times including twice in succession to become the personal property of the

* *Miscellaneous Publications*, No. 43, "Guide to the Conduct of Clean Milk Competitions," price 6d. net, post free.

winner. In addition, certificates were given to six competitors and their regular milkers who reached a sufficiently high standard. Money prizes were given to the employees on the farms of the leading four competitors.

This competition, in common with others held in different parts of the country, serves to confirm the view that in the production of clean milk, methods are of more importance than expensive buildings and elaborate machinery. It shows that the chief essential is attention to detail, until a satisfactory routine of clean methods has been established; and, further, that an intelligent interest must be shown by farmers and their employees.

Four Northern Counties Competition.—In the case of the Armstrong College competition, a series of clean milk demonstrations on farms had been given previously. It was found that this work was fruitful in producing a much better understanding of the essential conditions for clean milk production. The competition commenced on 1st March, 1924, and lasted five months. There were 40 competitors (Northumberland 17, Cumberland 17, Westmorland 4 and Durham 2) and this number would undoubtedly have been much greater had it not been for serious outbreaks of foot-and-mouth disease in the area shortly before the competition commenced.

The awards were based on a scale of points approximating that subsequently recommended in the Ministry's Guide, attention being given to the bacterial and chemical composition of the milk, the general health of cows, methods of milking and general management, and the condition of byres and buildings so far as they were directly under the control of the competitor. Competitors were required to send to Armstrong College samples of milk for bacteriological and chemical examination on request; such requests were sent at irregular intervals and only short notice was given. Each farm was visited at least twice, and in most cases three times, by the inspecting judges, and on these occasions surprise samples of milk were taken.

249 samples were examined of which 166 were submitted by farmers and 83 were taken by the inspecting judges. From the following statement it will be seen that more than half the samples submitted were of a standard above Grade A.

Standard Reached.	*Number of Samples.*	*Percentage.*
Certified	90	36.14
Grade A	49	19.67
Below Grade A	110	44.17

A Challenge Cup was awarded to the winner of the competition and a silver medal to the second competitor. Two competitors were placed equal for the third place, each of them receiving a bronze medal. Certificates were awarded to the ten leading competitors, whose work reached an exceedingly good standard. Printed recognitions were given to the workers on these farms, and money prizes were awarded to the employees on the four prize-winning farms. The prizes to farmers and certificates to workers were given by the National Milk Publicity Council.

In the reports on the competition it is stated that whilst with few exceptions the methods employed by the competitors at the beginning of the competition were not good, many improvements were noticed when the final inspections were made. Milking machines were in use on three farms, but in no case were the results so satisfactory as on those farms where clean hand-milking was practised. It is again reiterated that it was only on those farms where not only were the buildings clean, and the utensils properly sterilised, but where the milkers were all keen and painstaking in their methods, that good results were obtained; and that whilst the importance of suitable cowhouses and buildings must not be underestimated, milk up to the standard of Certified Milk was produced on farms where the buildings must be classed as inferior.

Full reports on both these competitions have been issued: (1) "Clean Milk in Yorkshire," by the Yorkshire Agricultural Society, and (2) "Clean Milk Competition, 1924," by the Agricultural Department of Armstrong College. These reports are very full and instructive, and a wide distribution has been made. That they have aroused considerable interest is evidenced by the generally expressed desire that further competitions should be held in 1925, and arrangements are in hand for the movement to be continued and extended.

* * * * * *

The Agricultural Index Number.

THE general level of the prices of agricultural produce during February was 67 per cent. above those ruling in the corresponding month of 1911-13. The index number therefore shows a decline of 3 points as compared with January, but is 6 points higher than in February of last year. The rise as compared with last year is due to wheat, barley, sheep and pigs, most other commodities being cheaper now than a year ago.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	—
April ...	202	149	70	54	53	—
May ...	180	119	71	54	56	—
June ...	175	112	68	51	58	—
July ...	186	112	72	53	52	—
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat averaged 8d. per cwt. more than in January, and the index figure advanced to 83 per cent. above pre-war, so that wheat was relatively the dearest grain and was making comparatively higher prices than most other commodities. Barley prices dropped sharply, though the decline would be occasioned to some extent by a larger proportion of the sales being of feeding qualities. Oats were slightly dearer than in January, but the rise was relatively smaller than in the basic years and the index figure was reduced by 4 points.

All classes of fat stock sold at higher rates on the month, but the rise of ½d. per lb. in the case of sheep was not so sharp as in pre-war years and the index number for these declined. The advance in fat cattle was 3d. per 14 lbs. stone, while bacon pigs rose by 7d. per stone and porkers by 4d. per stone. The index figure for fat pigs has risen each month since July, 1924, and is now 61 per cent. above 1911-13 against only 31 per cent. eight months ago.

The demand for dairy cattle has not been brisk, as the mild weather has conduced to the flow of milk being well maintained, and on the average cows sold at about 15s. per head less than in January. All classes of store stock became dearer last month, but the rise in pigs and sheep was relatively not quite so large as in 1911-13.

Butter averaged 2d. per lb. less than in January, and was 1¼d. per lb. cheaper than in February, 1924. Eggs also realised less money than a year ago, the decline in February being much sharper than last year and in the basic years, and the index number fell by 20 points. Cheese was 2s. 6d.

per cwt. dearer than in January, but the index number rose by 1 point only. Milk was unchanged on the month.

Prices of potatoes became rather easier during February, the average fall being about 5s. per ton, and for the first time for many months the index number is lower than a year earlier. The index number of other vegetables declined by 7 points to 74 per cent. above pre-war. Carrots remained very cheap at 27 per cent. above 1911-13, and cabbage declined on the month to only 40 per cent. above pre-war. Celery remained unchanged at rather over double the price in the basic years, and cauliflowers, though 5d. per dozen cheaper than in January were $2\frac{1}{4}$ times the pre-war price. Brussels sprouts advanced by 1s. 2d. per cwt. and at 62 per cent. above 1911-13 were 11 points up on the month, and onions rose sharply to 81 per cent. above the price in the basic years.

Index numbers of different commodities during recent months and in February, 1923 and 1924, are shown below :—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.			1925.	
Commodity.	Feb.	Feb.	Nov.	Dec.	Jan.	Feb.
Wheat ...	28	44	68	67	76	83
Barley ...	12	43	89	76	81	59
Oats	39	41	45	37	46	42
Fat cattle ...	61	54	47	44	52	53
Fat sheep ...	97	75	90	84	107	100
Fat pigs ...	88	34	45	49	59	61
Dairy cows ...	67	48	60	55	53	50
Store cattle ...	36	39	36	37	43	46
Store sheep ...	100	89	94	85	102	100
Store pigs ...	154	50	33	38	49	48
Eggs... ...	46	75	84	51	82	62
Poultry ...	80	52	62	64	63	56
Milk	90	87	82	84	84	84
Butter ...	72	71	74	73	73	62
Cheese ...	88	72	38	51	49	50
Potatoes ...	—5*	170	168	166	152	144
Hay	42	—1*	1	2	1	0

* Decrease.

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Veterinary Tests for Poultry Diseases.

THE Ministry announces that owing to the increasing number of poultry submitted to the Ministry's Veterinary Laboratory for post-mortem or other examination, it has been found necessary to appoint a special officer to undertake this examination work. It has also been decided to institute a scale of fees to be charged as from 16th March last.

The charge for an ordinary post-mortem examination will be 3s. a bird. In the case of flocks suspected of being infected with Bacillary White Diarrhœa, an inclusive fee of 10s. is payable, in respect of whatever number of tests are required to establish, or otherwise, the existence of the disease in the flock. In all cases where a number of chicks have died it is desirable that several should be sent for examination. In flocks where this disease is found the remaining birds will be tested for elimination purposes at an additional fee of 1s. a bird. In all cases fees are payable in advance.

Special terms will be allowed where birds are submitted in numbers (*e.g.*, from egg-laying competitions) for post-mortem examination or for the agglutination test for bacillary white diarrhœa. Particulars may be obtained from the Ministry's Veterinary Laboratory, New Haw, Weybridge. (Station: Addlestone, S.R.). Birds submitted for post-mortem or other examination should be sent direct to that address, carriage paid, accompanied by the necessary remittance, and accompanied by the name and address of the sender. Postal orders, etc., should be made payable to "The Ministry of Agriculture and Fisheries" and crossed "& Co."

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Amendment of the Canadian Seed Importation Regulations.

ARTICLE 6 of the Canadian Seed Importation Regulations, which was in operation up to 1st October, 1924, provided that shipments of seeds marked with a grade, or, in the case of field root and garden vegetable seeds, with the percentage of germination, might be released by the Collector of Customs without delay if a Canadian Government Seed Laboratory test number was given as authority for grade or percentage of germination stated. It is understood that few importers availed themselves of the facilities for getting a Canadian test made before shipment, so that, in most cases, imported lots had to be held up by the Customs until an official test was completed. The delay in the delivery of imported seeds caused in this way, is said to have

seriously handicapped business, and in order to meet these difficulties the Canadian authorities have now amended Article 6 to read :—

"Delivery without examination or bond.—The Collector of Customs may, after taking a sample for test, deliver shipments of seed to consignees without further examination or bond: (1) when the invoices are accompanied by a certificate issued by an official seed testing station, of any country or state, which official seed testing station has been approved by either the Association of Official Seed Analysts of North America or the International Seed Testing Association, showing the percentage of pure living seed and the proportion of weed seed to conform to the minimum standards required for the kind of seed under the Seeds Act and regulations; or, (2) when the invoices or containers are marked with a control sample certificate number from a Canadian seed inspection office showing that the seed conforms to the minimum standards required for the kind of seed under the Seeds Act and regulations, and including: (*a*) for seed imported under grade, the name of the grade of seed and the serial number of the certificate; (*b*) for seeds of rape, field roots and garden vegetables, the serial number of the control sample certificate.

"The privilege hereby extended of delivering seed without examination or bond may be withdrawn at any time by the Minister if the imported seed does not within the limits of reasonable variation conform to the control sample that is held by the official seed testing station which issued the certificate that is attached to the invoice or container."

The Seed Testing Stations in Europe whose tests are valid for the purpose of this regulation are as follows: England (Cambridge); Scotland (Edinburgh); Ireland (Dublin, Belfast); Denmark (Copenhagen); Norway (Trondhjem); Sweden (Orebro); Germany (Hamburg, Munich, Breslau); Holland (Wageningen); Belgium (Louvain); France (Paris); Switzerland (Zurich); Austria (Vienna); Czecho-Slovakia (Prague); Hungary (Budapest); Roumania (Bukarest); Italy (Bologna); Finland (Helsingfors).

* * * * * *

Exchange of British and Danish Agriculturists.

Last year the Ministry arranged, through the Agricultural Commissioner of the Danish Government, for a limited number of young agriculturists from this country who were desirous of securing practical experience of Danish agriculture, to be placed for work on farms in Denmark. Similarly, arrangements were made for an equal number of young agriculturists from Denmark to be placed on farms in this country. Approved applicants were required to pay their own travelling expenses to and from their destination, and to undertake regular work on a farm, for a period of from three to six months, in return for free board and lodging. No money was payable to them.

On the whole the scheme worked satisfactorily, and it has therefore been decided to continue it, on the same lines, during 1925. The National Farmers' Union is giving assistance in the selection of farms where Danish agriculturists may be received, and in securing suitable British applicants for placing on Danish farms. Applications from young agriculturists in this country may be sent to the Ministry of Agriculture, and will be transmitted to the Danish Agricultural Commissioner.

* * * * * *

Prohibition of Importation of Potatoes from Canada.

IT will be remembered that in December last the Ministry felt it necessary to prohibit the importation into England and Wales of potatoes grown in the United States in order to guard against the importation into this country of the destructive Colorado Beetle with which the potato fields over large areas of the States are infested. It was recognised at the time that consideration would have to be given to the necessity for similar action in regard to potatoes grown in Canada, and inquiries were accordingly made as to the prevalence of the Colorado Beetle in the potato-growing districts of the Dominion. It appears as a result of these inquiries that the continued importation of Canadian potatoes involves a risk of the introduction of the beetle into this country, and the Ministry has accordingly issued the Colorado Beetle Order of 1925 prohibiting the importation into England and Wales of potatoes grown in Canada. The Order came into operation on 20th February, but provision was made for the admission of any consignments shipped before that date.

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Vaccination of Animals against Tuberculosis.

THE Ministry has recently undertaken to test a special method of vaccination of animals against tuberculosis. The vaccine used in the test is the result of many years of work by two distinguished scientists, Dr. Calmette and M. Guerin. It is not claimed by them that the vaccine is an effective preventive, but merely that the promise of preliminary experiments entitles it to a trial in the field of practice—a trial which is unlikely to be completed in less than five years. The Ministry does not hesitate to say that it is unable at present to encourage those farmers who are at the present time considering the use of a vaccine in the belief that a solution of the problem has been reached. With regard to the trials conducted by the Ministry, the material for the vaccine costs only a few pence

per dose, and is being issued, in those cases which are selected for trial, free of charge.

These facts should be borne in mind by stock-owners, should they be recommended to use any vaccines against tuberculosis which have not been fully tested out in practice. In this connection, it should be remembered that all attempts in the past to immunise animals against tuberculosis with killed bacilli have definitely failed in their purpose. The Calmette-Guerin vaccine which the Ministry is trying out is a living one.

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Poultry for Improving Poor Pastures on Light Soils.

THE Ministry's attention has been drawn to a striking illustration of the value of running poultry on poor pastures on light soils. This occurred on a manurial demonstration plot which was one of a series arranged by the Agricultural Education Sub-Committee of the Worcestershire County Council. The soil consisted of sandy to gravelly loam over a sandy to gravelly subsoil. The turf was comparatively young and the chief grass hard fescue with, mainly, bent, Yorkshire fog and sweet vernal; cocksfoot and perennial rye-grass were also present. The leguminous species included minute plants of white clover and narrow-leaved vetch. Composite weeds were abundant and also mouse-ear chickweed, sorrel and moss. At one end of the field a large flock of poultry with free range has been fed for two seasons. The change which has been effected in the composition of this rather singular type of mixed herbage has been remarkable. Where the poultry congregated most, white clover has increased to such an extent that it has almost blotted out all other plants. A diminishing effect is observable as the range widened. In this way, a good method of improving poor pastures on light soils has been strikingly demonstrated at this centre which is well worth consideration in other suitable cases.

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Egg and Chick Distribution Scheme, 1925.

A SCHEME has been in operation in the early part of the year for several seasons now to assist county education authorities in the distribution of sittings of eggs and day-old chicks, with the object of improving the breed of poultry kept by the smaller poultry-keepers and cottagers in rural districts.

The main points of the scheme are the approval and regular inspection of stations from which sittings of eggs and day-old chicks at a specified and moderate price are supplied to applicants

resident within the county. The owners of these approved stations, called "station-holders," are appointed for the season and receive a small subsidy in addition to the price for eggs or chicks paid by the purchaser. It is a condition that the poultry stock at the station shall consist of pure-bred birds of good utility quality, and it is the duty of the County Poultry Instructor to select the stock of a station and to mark it. When the station has been approved, the management of the birds and the manner in which the work of distribution of eggs and chicks is carried out are put under the general supervision of the County Poultry Instructor.

The prices fixed by county education authorities for sittings of eggs now range between 3s. 6d. and 7s. a dozen, and for day-old chicks, 7s. to 14s., with an additional charge for carriage and box when sent by rail or post. In order to encourage a higher standard of stock at the stations this year, higher prices and premiums than in previous years are being allowed for eggs and chicks from selected trap-nested hens. The details of the prices and premiums are as follows:—

(a) *Non-trap-nested Stock.*—3s. 6d. to 5s. per dozen eggs, 7s. to 10s. per dozen chicks and ducklings. Premiums: 1s. 6d. per dozen eggs, 3s. per dozen chicks or ducklings.

(b) *Trap-nested Stock.*—5s. to 7s. per dozen eggs, 10s. to 14s. per dozen chicks and ducklings. Premiums: 2s. 6d. per dozen eggs, 5s. per dozen chicks or ducklings.

The station-holders are recognised under either (a) or (b), but not under both. The season for the distribution of sittings of eggs will last up to 30th April and for chicks up to 15th May.

It is interesting to record the increasing popularity of this scheme. Taking the last six completed years, the figures show that the number of stations has increased from 163 in 1919 to 316 last year, whilst the number of eggs has increased from 52,980 in 1919 to 107,960 in 1924, and the number of chicks from 2,974 in 1919 to over 49,000 in 1924. Orders for eggs and chickens, together with the necessary remittance, should be sent direct to a station-holder. The addresses of station-holders, together with full particulars of the county scheme, may be obtained on application to the Agricultural Organiser in those counties which have adopted the scheme. No doubt those requiring eggs or chicks will see to it that they send to the nearest station-holder and will give their full names, addresses, and nearest railway station. They should always endeavour to arrange for delivery by hand if possible, in order to avoid risk of delay or rough handling in transit.

THE Ministry has suggested to local education authorities that a system of demonstration work which is now undertaken in a few counties might, with advantage, be extended to all. These demonstrations are designed simply to exhibit the best modern practice, in one definite matter and on a fairly large scale, to farmers in a district where that practice is not known, or at least not generally adopted. The demonstrations would thus be limited to certain specific points which can be brought out clearly and without risk of confusion. Such questions, for example, as the application of North African phosphate, or an increased application of certain artificial manures, to arable land, or the use of improved seeds mixtures in pastures, or of improved varieties of wheat, oats, barley, etc., or the spraying of charlock could, it is thought, be taken up with very considerable advantage, particularly in the more backward districts. It will be especially useful if in those cases where merely a change of practice is to be demonstrated, the ordinary practice can also be shown side by side with the new practice. Where possible, all demonstrations in one county will be shown on the same farm.

Demonstrations in Modern Agricultural Practice.

It is understood that the suggested extension of this type of demonstration work, either in place of, or supplementary to, the existing county demonstrations and experiments, is being considered with favour in many counties.

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A MEETING of the Agricultural Wages Board was held on 10th March, at Gwydyr House Annexe, Whitehall, S.W.1, the Chairman, Lord Kenyon, presiding.

Farm Workers' Minimum Wages.

The Board considered notifications from various Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the necessary Orders carrying out the Committees' decisions, and specifying the date from which the rates should become effective; the date specified being 16th March in each case (except where otherwise mentioned below).

The rates thus fixed are, in the case of male workers 21 years of age and over, as follows:—

Cornwall.—For nine months, 31s. for 51 hr. Overtime at 9d. per hr. on weekdays and 10d. per hr. on Sundays.

Devon.—For three months, 32s. 6d. for 50 hr. Overtime at 8½d. per hr. on weekdays and 10d. per hr. on Sundays. (The operation of the overtime rates is deferred until the Committee have defined overtime employment.)

Lancashire: Southern Area.—Stockmen and teamsmen, 37s. for 52½ hr.; other adult male workers, 33s. 6d. for 50 hr.

Eastern Area.—42s. for 60 hr.

Northern Area.—Stockmen and teamsmen, 40s. for 60 hr.; other adult male workers, 37s. 6d. for 60 hr. Overtime in each area 1s. per hr.

Monmouth.—For twelve months, 32s. for 50 hr. in summer (first Monday in March to the day before first Monday in Nov.) and 48 hr. in winter (the remainder of the year). Overtime at 9½d. per hr. on weekdays and 11½d. per hr. on Sundays.

Northumberland.—Until 12th May, 1926, stewards, horsemen, cattlemen, stockmen or shepherds hired by the week or longer, 41s. for customary hr. in the case of such workers who are householders, and 38s. for workers who are not householders. (A week of customary hr. is defined as meaning not exceeding 62 hr.) Other male workers (except casual workers), 34s. for 48 hr. in winter (the Monday following the last Sunday in Oct. up to the Sunday previous to the first Monday in March), and 52½ hr. in summer (the remainder of the year). Male casual workers, 7½d. per hr. Overtime (except for casual workers), weekdays at time-and-a-quarter, Sundays at time-and-a-half.

Somerset.—Until 29th September, 1925, 32s. for 52 hr.

Carmarthen.—Until 14th Nov., 1925, 30s. for a seven day week of 54 hr., with overtime at 8½d. per hr.

Glamorgan.—Until 1st March, 1926, 37s. 6d. for 53 hr. in summer (1st March to 31st Oct.) and 51 hr. in winter (the remainder of the year). Overtime at 10d. per hr. weekdays and 11d. per hr. Sundays.

The above 8 Orders complete the bringing into operation under the Agricultural Wages (Regulation) Act, 1924, of minimum rates of wages for all classes of male workers employed in agriculture throughout England and Wales, the rates for the areas of the other 39 Agricultural Wages Committees being already in force.

The above Orders all include minimum rates for male workers under the age of 21, and also, except in the case of Somerset, for female workers. The principal rates for female workers are:—

Cornwall.—Aged 20 and over, 5d. per hr.

Devon.—Aged 20 and over, 5d. per hr.

Lancashire.—Aged 18 and over, 6d. per hr.

Monmouth.—Aged 17 and over, 6d. per hr.

Northumberland.—Aged 18 and over, other than casual workers, 5d. per hr.; casual workers, 3d. per hr. Overtime, 1d. per hr. more.

Carmarthen.—Aged 18 and over, 5d. per hr. for 8 hr. per day. Overtime at 6d. per hr.

Glamorgan.—Aged 18 and over, 6d. per hr. for 8½ hr. per day. Overtime, 7d. per hr. on weekdays and 7½d. per hr. on Sundays.

The Board also made the following Orders for areas for which rates were already in operation:—*Gloucester*: Minimum rates of wages for carters, shepherds and stockmen under 21 years of age, together with an amended Sunday overtime rate for adults of those classes and overtime rates for all male workers under 21

Holland: An Order continuing the operation of the minimum rates already in force (which are due to expire on 5th April) up to 31st October, 1925, the only amendments being that the weekly minimum rates will be payable as from 5th April in respect of a week of 52 hr. instead of 48 hr. as at present, and an addition of 1s. per week to the special payments for cattlemen and shepherds. *Shropshire*: An Order cancelling the present rate for male workers for time in excess of 54 hr. and under 57 hr. and fixing overtime rates for all time in excess of 54 hr.; the overtime rates for male workers aged 21 and over being 8d. per hr. for employment in excess of 54 hr. and under 60 hr., and 9d. per hr. for employment in excess of 60 hr., and for all employment on Sundays.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

The next meeting of the Board will be held on Wednesday, 25th March, 1925.

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Sugar-Beet Industry.

THE Ministry desires to point out to farmers within a working radius of the existing beet-sugar factories, and of those in course of erection, that these factories require a further contracted acreage in order that, with the assistance of the subsidy now to be granted on sugar produced, they can make an effective start in establishing the sugar-beet industry in this country on a broad and stable basis and justify the large expenditure of capital to which the manufacturers stand committed.

The subsidy scheme has been designed in the belief that the beet-sugar industry will prove of great national value, but the success of the scheme necessarily depends on the support of the farming community. The Ministry feels, therefore, that having regard to the fact that the prices offered to the farmers for their beets have received the approval of the National Farmers' Union and are likely to ensure a reasonable return on the costs of production, every farmer should give serious consideration to the introduction of sugar-beet cultivation into his farming programme.

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AGRICULTURE ABROAD.

American Institute of Co-operation.

THE first session of the American Institute of Co-operation, the formation of which was referred to in this *Journal* for November last, p. 703, has been announced to take place at the University of Pennsylvania, Philadelphia, from 20th July, to 15th August, 1925.

The object of the Institute is to provide a source from which members, employees and officers of co-operative marketing

organisations, teachers of marketing in universities and colleges, public marketing officials and private and public research workers will be able to secure training. Practical experience and knowledge will be pooled for mutual benefit and the advancement of sound co-operation.

The staff of the Institute will include picked men from a wide range of co-operative organisations and from the leading educational institutions. In addition, several authorities of international reputation will attend from Europe.

The topics for study at the first session have been settled as follows:—

First Week: Economic Principles and Legal Structures of Co-operation.

History of Co-operation.	Possibilities and Limitations.
Ideals of the Movement.	Status of State and Federal Legislation.
Development of Types.	Education in Co-operation.

Second Week: Organisation and Membership Problems.

Preliminary Market Surveys.	Patronage Costs.
Forms of Organisation.	Educational Work with Members.
Organisation Finance.	The Co-operative and the Community.

Third Week: Operating Methods and Management Problems.

Source of Personnel.	Warehousing
Business Practices.	Grading and Standardisation.
Auditing and Accounting.	Methods of Pooling.
Marketing Finance.	

Fourth Week: Sales Policies and Price Problems.

What is Meant by Orderly Marketing?
Selling Plans for Principal Commodities.
The Development of Markets.
Price Objectives of Co-operatives.
Selling Problems.
Credits and Collections.
Effect of To-day's Price on To-morrow's Production.

The project is said to have the backing of organisations representing over two million American farmers and to be officially recognised by State Departments of Agriculture, State Bureaux of Markets, and the Federal Department of Agriculture at Washington.

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New Australian Agricultural Research Institute.

THE Waite Agricultural Research Institute has been established by the University of Adelaide for the purpose of conducting investigational and research work in agriculture. The establishment of the Institute was rendered possible by the magnificent gift of the late Mr. Peter Waite, a sheep farmer of South Australia who bequeathed £100,000 to the University of Adelaide for agricultural

research. The Government of South Australia has supplemented the bequest by an appropriation equal to the annual value of the endowment, namely, £5,000 per annum. The Institute is located at Glen Osmond, $3\frac{1}{2}$ miles from Adelaide on an area of 300 acres of good agricultural land. With the funds available it is proposed to conduct investigational work in agronomy, agricultural chemistry, plant pathology and plant genetics.

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Expenditure of the U.S.A. Department of Agriculture, 1924-5.

IN the "Experiment Station Record" for July, 1924, appeared an account of the funds provided by Congress for the use of the Department of Agriculture during the year ending 30th June, 1925. The total sum provided for agriculture was $51,936,000 (at $4.60 to the £, approximately £11,290,000) compared with $55,447,000 for 1923-24. A number of further items of expenditure, however, were approved by both Houses of Congress, but the Bills failed to pass before the close of the Session. These included $3,500,000 (£760,000) for foot-and-mouth disease. It is stated that taking all these factors into account the ultimate total provision for the work of the Department seems certain to be somewhat in excess of that of any previous fiscal year.

The main divisions of the Department's work and the funds provided for them were as follows (at $4.60 to the £) :—

	£
Office of the Secretary	1,459,000
Weather Bureau	440,000
Bureau of Animal Industry	1,636,000
Bureau of Plant Industry	802,000
Forest Service	1,735,000
Bureau of Chemistry	302,000
Bureau of Soils	85,000
Bureau of Entomology	449,000
Bureau of Agricultural Economics ...	940,000
Bureau of Biological Survey	194,000

The programme being carried out by the Department during the year is largely a routine one. The principal items of increase are, as a rule, in connection with the regulations enforced by it or for the enlargement of control work directed against particular pests and diseases. The commencement of comparatively few new research projects is authorised, and the Department's prevailing policies and schemes will be continued without material modification.

NOTICES OF BOOKS.

Crop Production in India.—(Albert Howard, C.I.E., M.A., Oxford University Press, 10s. 6d. net.) This book deals with the problems which present themselves to farmers, and to those engaged in agricultural research in India. It has been written with the idea of enlisting the interest of the general public in these problems, and in the measures that are being taken to solve them; it has the subsidiary purpose of encouraging this work, and attracting to it a number of active and enthusiastic investigators.

It is divided into three sections, the first of which deals with the soil, the second with the crop, and the third with the organisation of research work. A good deal of emphasis is laid upon the place of agriculture in the economics of India, because, as the writer correctly says, agriculture will be the primary industry of India for many years yet to come, and it is of the utmost importance that the necessary research work should be done to enable the best results to be obtained by those engaged in the industry.

In all tropical countries the problem of primary importance to agriculture is that of dealing with the water supply, and this problem presents itself no less in India than elsewhere. By quoting a series of examples of damage resulting from the heavy rainfall during the monsoons, and the local and comparatively small adoption of systems of conservation of the water supply, the writer explains these problems. He points out that surface drainage is of the utmost importance because the "run off" erodes the fertile soil, and has in some parts destroyed the agricultural value of many thousands of acres by the creation of deep ravines extending in a network about the main channel of a river. The wealth of water is thus not only valueless, but actually harmful, and must be dealt with before the results of crop research can be of real service to the agricultural population.

Mr. Howard examines the work, which has so far been done on each crop cultivated in the peninsula, and he provides a bibliography covering each section of this work for the benefit of those readers of his book whose interest may be sufficiently aroused.

Part three of the book deals with the organisation of research work, and makes a comparison of the methods of finance and organisation in different countries, but, although he makes tentative suggestions, the writer might possibly have explored this part of the subject more fully.

Farmers and the C.W.S.—(Published by the Co-operative Wholesale Society, Ltd., 118, Corporation Street, Manchester.) This is an interesting booklet which aims at demonstrating the advantages of inter-trading between the agricultural and industrial co-operative movements. The latter, to quote the booklet, "with its experience, numbers and power, holds out its hand to British agriculture. It invites co-operative farmers, as essential producers and consumers themselves, to share in the commerce and in the mind and spirit of British co-operation."

Practical Buttermaking.—C. W. Walker-Tisdale, F.C.S., and Theodore R. Robinson, F.S.I. London: The Swarthmore Press, Ltd., price 3s. 6d. net.) This book is usually regarded as one of the standard works on buttermaking, as carried out on the farm. Formerly it contained a section devoted to "Buttermaking at the Creamery,"

as mentioned on page 111, and it is to be regretted that this section has now been dropped.

The illustrations are excellent, the book is well arranged and altogether should prove very useful to the student attending either a travelling dairy school or a dairy course at a farm institute, etc., and still more useful to those who cannot attend either.

The Agricultural Situation.—(G. F. Warren and F. A. Pearson. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1924. Price 15s.) This admirable book makes an important contribution to the study of the economic causes underlying agricultural prosperity or depression. Although it is concerned primarily with conditions in the United States, the subject is treated broadly and the general economic conditions are applicable to agriculture wherever it is practised.

The greater part of the book is concerned with the study of American agriculture during the decade following the year 1914, that is to say, during a period of acute economic disturbance in which the general level of prices was first rising rapidly and then falling still more rapidly. The price movements of all the primary products of agriculture are studied individually and illustrated diagramatically during the inflation period, and deflation period respectively. The relation of farm prices to the prices of commodities the farmer had to buy are similarly examined, as also is the course of taxation, bankruptcies, and other economic factors reacting upon the welfare of agriculture. A valuable chapter deals with the indirect consequence to agriculture of monetary instability, and a further chapter refers to other agricultural depressions, showing how much the variations in the purchasing power of money have been responsible for the periods of depression which occurred in the earlier part of the 19th century.

The book once more provides a demonstration, admirably supported by statistical tables and diagrams, of two facts which happily are now being written about and understood much more widely than hitherto: firstly, that the agricultural depression which began in 1920 was brought about primarily by monetary causes; and secondly, that in previous periods of depression monetary causes have played an important if not predominating part. To agriculture unstable money is disastrous.

When they turn to the probable future course of prices, a subject of supreme importance to agriculture, the authors are perhaps on more debatable grounds. On this matter they are pessimistic. Their considered opinion is that the general level of prices will gradually fall owing to an inadequate supply of gold. They are apparently sceptical about the ability of the Federal Reserve Banks and the Central Banks of other countries to cope with the situation:—

> "Some people believe that with the federal reserve system prices will be maintained at a high level. It may be recalled that this argument was used in 1919, and with the federal reserve system there occurred the most violent drop in prices of which we have a statistical record in America."

But this seems to imply that the Federal Reserve Board have learned nothing since 1919. As a matter of fact they have learned a great deal, as is shown (amongst other things) by the comparative steadiness of American prices during the last three years, notwithstanding the

continued inflow of gold. The future course of prices may be uncertain, but it is reasonable to hope that joint action of the Federal Reserve Board and the Bank of England may succeed in preventing the wide variations in the commodity value of gold such as occurred in the 19th century, with their attendant harmful consequence to agriculture.

Fruit Pollination in Relation to Commercial Fruit Growing.—(Cecil H. Hooper, M.R.A.C., F.L.S. Fruit Bulletin 10, 1925; South-Eastern Agric. Coll., Wye, 8 pp., price 1s.) In this bulletin, which is reprinted from the "Fruit, Flower, and Vegetable Trades Review," the pollination of both bush fruit and top fruit are dealt with. The varieties of apples, pears, plums and cherries are shown as being sterile, partially fertile or self fertile, and are further classified according to their order of flowering. Mr. Hooper believes that the bumble bees, the hive bees, and the small wild bees are the most valuable as transporters of pollen. A useful bulletin giving much information in a condensed form, which should be valuable to growers, even outside the Kent area.

A Textbook of General Botany for Colleges and Universities.—(Richard M. Holman and Wilfred W. Robbins, 570 pp. New York: John Wiley & Sons, Inc.; London: Chapman & Hall, Ltd., 1924. Price £1.) In few things does the personal factor enter more strongly than in the making and in the choosing of textbooks; the present work, however, is one which will make many friends. The authors are men who hold high teaching posts in the University of California, and as an outcome of their experience have aimed at producing a work which can take the place of lecture notes and allow the teachers to devote more time to practical work, etc. There are many in this country whose sympathies are with this point of view. The book possesses two outstanding features: it is admirably illustrated and it is well supplied with summaries and contrasting paragraphs, arranged in parallel columns. Many of the illustrations are original, most of them are diagrammatic, and some are of especial interest; those which are not original possess the advantage that they are mostly new to textbooks. It is worth while drawing attention to Fig. 126, on p. 161, which is not our common Ivy (*Hedera helix*), but the common *Ampelopsis Veitchii.* There are two parts. Part I (pp. 1-316) deals with the anatomy, morphology and physiology of the Spermatophytes, using well-known agricultural, arboricultural and horticultural species as examples. Part II is mainly devoted to a short study of fungi, ferns, etc., but to these are added accounts of the life history of a gymnosperm (pine) and of a cereal (wheat), and also a chapter on evolution and heredity. While the book is designed as a class-book for the teacher who wishes to teach rather than lecture, it will also be invaluable for the student working by himself and for the student who wishes to supplement his notes. It does not include systematic botany of the higher orders—which is usually specialised for each particular branch of study—but otherwise it is eminently suitable for those taking degrees in agriculture, forestry, horticulture, medicine, etc. The authors have had a clear conception of what they consider necessary, and their arrangement will appeal very strongly to many modern teachers and students.

Year Book of the National Farmers' Union, 1925. (National Farmers' Union, London: Price 1s.) This publi-

cation consists of fourteen sections, dealing with subjects of importance to agriculturists at the present time. It should be of much value to members, and is calculated to demonstrate to all farmers who are not yet members of any farmers' association the importance, indeed necessity, of combination, if agriculture is to hold its own with opposing interests. Section I ought to be very useful: it contains, for each county, a list of agricultural educational institutions, experimental or demonstration stations, agricultural organisers, centres to which farmers may apply for advice, and the Ministry's livestock officers. A sketch is also given of the activities of these various officers and centres in assisting farmers, and of the progress of research during 1924. A section dealing with the farmer's income tax, by Mr. Chas. H. Tolley, A.C.I.S., contains all the information required by both tenant farmers and occupying owners, who naturally do not wish to pay more than they are properly liable for. Notes on tithes and land tax are also included.

The possibilities of co-operation for farmers are discussed in a section which is of particular importance, as the National Farmers' Union has undertaken on behalf of its members to carry out certain work hitherto performed by the Agricultural Organisation Society, which has now come to an end. It is stated that the number of societies working on successful lines and giving satisfaction to their members is a proof that, given the right condition and efficient management, advantage can accrue from this form of combination. It is the wish of the Union when approached by any group of farmers desiring to co-operate for specific purposes to do its best to help them to render any scheme which is launched as proof against risk of failure, as it is possible to make any commercial scheme. In a section dealing with the sugar beet industry the successful efforts of the Union to secure contracts on improved terms for growers in 1923 and 1924 are described, and a similar account of the negotiation with regard to milk contracts for 1924-5 is contained in the account of the work of the Milk and Dairy Produce Committee. These afford a striking exemplification of the value to farmers of collective bargaining through the National Farmers' Union when they are dealing with organised manufacturers or distributors.

Other sections deal with Legislation affecting Agriculture in 1924, Labour, Prices and Supplies, Facts and Hints on Railway Transport, Government Departments, and other subjects, in addition to a complete account of the many-sided work of the Union during the year, and a large amount of information of a reference nature. A good index greatly increases the usefulness of the Year Book.

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Importation of Plants, Bulbs, etc., from the United States of America.—The Ministry desires to remind importers of plants, bulbs, etc., from the U.S.A., of the importance of arranging for consignments to be accompanied by official certificates of health in the form prescribed in the Destructive Insects and Pests Order of 1922. This Order requires that plants imported into England and Wales shall be accompanied by a certificate issued by a duly authorised official of the country of origin not more than 14 days prior to the date of shipment of the consignment to the effect that the plants, etc., have been inspected and found to be healthy and free from certain specified diseases and pests.

The certificates of inspection of nursery stock issued by certain State officials under the Farms and Markets Law of the United States cannot be accepted as complying with the requirements of the Destructive Insects and Pests Order, and consignments arriving in this country with such certificates only will be treated as uncertificated consignments, examination of which will be required to be made by one of the Ministry's Inspectors at the expense of the importer.

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Agricultural Exhibition in Belgium.—An international agricultural exhibition is to be held at Liège from 4th to 13th July, 1925, which is to be honoured by a visit from the King and Queen of Belgium.

In addition to sections covering horticulture, poultry keeping and bee keeping, there will be an important section devoted to agricultural education, a dog show, and an exhibition of agricultural machinery and implements.

The exhibition is to be organised by the Société Royale Agricole de l'Est de la Belgique, and 150,000 francs has been set aside for the construction of stands, etc., and 160,000 francs for prizes.

Endeavours will be made to obtain the admission of exhibits free of customs duty.

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Foot-and-Mouth Disease.—Two fresh centres of disease have occurred since the March issue of the *Journal* was published, disease being confirmed on 2nd March at Rudheath, Northwich, Cheshire, and on 14th March on premises near Yarmouth, Isle of Wight. The usual restrictions were applied to the surrounding area of 15 miles radius in the first case, and to the Isle of Wight in the other case.

There have been no developments of the disease in respect of the areas referred to in the March issue of the *Journal*, and in all cases the restricted areas have been either materially reduced or entirely released from restrictions.

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Leaflets issued by the Ministry. — Since the date of the list given on p. 887 of the December, 1924, issue of the *Journal*, the following leaflets have been issued:—

New:—No. 76. Wire Fencing for Grassland.
,, 91. Peppermint: Its Cultivation and Distillation.
,, 99. Loans for the Purchase of Lime.
,, 103. Young Farmers' Clubs. (Boys' and Girls' Agricultural Clubs.)
,, 104. Feeding for Winter Beef Production.

Re-written:—No. 164. Potato Leaf-Roll.
,, 242. Stripe Disease of Tomatoes.

Revised:—No. 56. Apple Canker.
,, 377. "Reversion" or "Nettlehead" of Black Currant.
,, 400. List of Publications.

Amended:—No. 81. A Substitute for Dishorning.
,, 105. Wart Disease.
,, 153. Storing of Mangolds and Turnips.

ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Brooks, F. T. (edit.).—Report of Proceedings of the Imperial Botanical Conference held at the Imperial College of Science and Technology, South Kensington, July 7-16, 1924. (405 pp.) Cambridge: University Press, 1925, 15s. [58.]

Morse, R., and *Palmer, R.*—British Weeds: Their Identification and Control. (207 pp. + viii pl.) London: Benn, 1925, 10s. 6d. [63.259.]

Seale-Hayne Agricultural College.—Pamphlet 14:—Spotted Medick (a Weed of Grass Land), by *E. W. Fenton.* (8 pp.) Newton Abbot, 1925. [63.259.]

Somerville, W.—Use of Basic Slag. Reprint from "The Times." (7 pp.) London: British Basic Slag, Ltd., 1925, gratis. [63.1672.]

Cole, G. D. H.—The Life of William Cobbett, with a chapter on "Rural Rides," by *F. E. Green.* (458 pp.) London: Collins, 1925, 18s. [92.]

Field Crops.

University of Leeds and the Yorkshire Council for Agricultural Education.—Report No. 137:—Results of Experiments with Cereals, Peas, Potatoes, Swedes, Turnips and Mangels in Yorkshire, 1924. (13 pp.) Leeds, 1925. [63.3.]

Canada Department of Agriculture.—Bull. 42 (New Series):—Experiments with Wheat at the Dominion Experimental Farm, Brandon, Manitoba. A Summary, 1889-1923. (54 pp.) Ottawa, 1924. [63.311.]

Fisher, R. A.—The Influence of Rainfall on the Yield of Wheat at Rothamsted. Philosophical Transactions of the Royal Society of London, Series B, vol. 213, pp. 89-142. London: Harrison & Sons, 1924, 5s. [63.311; 551.5.]

Minnesota Agricultural Experiment Station.—Bull. 206:—Wheat and Flax as Combination Crops. (12 pp.) St. Paul, 1924. [63.311; 63.34111.]

Minnesota Agricultural Experiment Station.—Bull. 212:—Potato Investigations at the North Central Experiment Station, 1914-1923. (58 pp.) St. Paul, 1924. [63.512.]

Horticulture and Fruit Growing.

U S. Department of Agriculture.—Farmers' Bull. 1431:—Greenhouse Tomatoes. (24 pp.) Washington, 1924. [63.513.]

Morton, J. W.—Profitable Bush Fruit Culture. (63 pp.) London: Ernest Benn, 1925, 2s. 6d. [63.41(*c*).]

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NOTES FOR THE MONTH.

Co-operative Marketing of Agricultural Produce.*

THE first of a series of reports on economic subjects connected with agriculture, which the Ministry has in preparation, has just been issued. A feature of the series will be reports based on the detailed investigations now being undertaken by the Department into commodity marketing and kindred problems. It is fitting, therefore, that the first report should be a survey of the present stage of development of the co-operative marketing movement in this country, for, as stated in the report, " there is a striking dearth of that responsible and comprehensive information which is necessary to enable the present position of the movement to be appreciated and understood and to serve as a basis for future effort and enterprise."

The report contains a mass of information derived from a careful and critical analysis of the returns and balance sheets of the societies themselves and from reports furnished by the Ministry's officers. All the usual forms of co-operative marketing activity, including livestock auction marts, slaughter-houses, bacon factories, the sale and processing of milk and dairy produce and the marketing of eggs, poultry, fruit, vegetables and wool are separately reviewed. The methods and results of a number of societies are described in detail by way of illustration, and the whole is adjusted as to perspective by an interesting historical background showing the development of the various forms of co-operative marketing in this country from the early days and the general trend of events which have affected the course of the movement as a whole during the past fifty years.

No such exhaustive survey of co-operative marketing has previously been attempted so far as this country is concerned.

* Report on Co-operative Marketing of Agricultural Produce in England and Wales (Economic Series No. 1), obtainable from His Majesty's Stationery Office, price 1s. 6d. (1s. 8½d. post free).

(60952) P.6./R.4. 8,250. 5/25 M. & S. A

Indeed, even the flood of literature relating to agricultural co-operation which is poured out in ever-increasing volume by other countries, contains nothing more intensive and informative regarding existing practice than the report just issued. It should prove of enduring value to all interested in the economic organisation of agriculture in this country, and though the progress and results which it records are, in a sense, disappointing, it may not be without interest also in those parts of the world where co-operation is the main constructive idea now being directed to the enhancement of marketing efficiency.

An important chapter of the report deals with the past efforts of societies at federation for trading purposes, and discusses the economic purpose and significance of federal action in the performance of extra-local marketing services. Another chapter of general application deals with inter-trading between the agricultural and industrial co-operative movements. A number of fundamental issues are brought together for discussion in the final chapter, and it is here that all routes converge. The importance of a careful and dispassionate analysis of the business situation before any new venture is launched, the importance of the management factor, of adequately paid management, of adequate turnover and capitalisation and the provision of reserves, of grading and standardisation, of a "safety-first" price policy, and last, but not least, the importance of membership contracts in ensuring a guaranteed supply of produce for each undertaking, are put with emphasis. The report shows conclusively that far more attention must be given to these considerations in future than has been customary in the past. Indeed, to the great majority of farmers, not excluding members of existing co-operative undertakings, co-operation is little more than a name, and it is unusual to find farmers who use their societies actively as their principal medium of business. As the report says, many farmers are, at present, merely "playing with co-operation and not committing themselves to a thorough-going experiment." It is in the light of these facts, therefore, that past failures must be viewed. It may even be held that co-operative marketing as understood and practised to-day in the Dominions and elsewhere has never been really tried out in this country. The way is, therefore, open for the future, but there appears to be no sure foundation on which to build until farmers, as a whole, more fully appreciate the purpose and significance of the principles underlying co-operative organisation and have satisfied themselves that, in the final

analysis, co-operative marketing, based on such principles, will, in fact, prove to be *better business;* only when so convinced are they likely to stand by the system in the manner and to the extent which is common in other lands, and to back it with all or an agreed proportion of the produce at their command.

* * * * * *

Conference of Agricultural Organisers at Oxford.

THROUGH the kindness of the authorities of Oxford University, of Balliol College, and of the School of Rural Economy with its Research Institutes in Agricultural Economics and Agricultural Engineering, a very representative Conference of Agricultural Organisers was held in Balliol College from 3rd to 8th April.

Part of the proceedings consisted in a joint discussion between Agricultural Organisers and Specialist Advisory Officers on their mutual relations, for which the attendance of the latter class of officers was necessary, and opportunity was taken at the same time to arrange sectional conferences of these latter officers in economics, chemistry, entomology and mycology. The various meetings were also attended by officers of the Ministry and by members of the staffs of the School of Rural Economy and the two Research Institutes, and some 150 persons in all were present during the conference. At various times the conference was attended by the Minister of Agriculture (Rt. Hon. E. F. L. Wood, M.P.), and the Parliamentary Secretary (Lord Bledisloe), Dr. L. R. Farnell (Rector of Exeter College, and Pro-Vice-Chancellor of the University), Sir Francis Floud and Sir Daniel Hall. A reception was held by the Minister on the evening of Friday, 3rd April, and a welcome was extended to the conference by the Rector of Exeter on behalf of Oxford University on Saturday, 4th April. The proceedings were formally opened by the Minister on the same day.

The principal aim of the conference was to discuss the principles of agricultural experimental work, with special reference to the question of experimental error; and papers on these subjects were read by Sir D. Hall, who dealt with the general principles of agricultural experiments; by Mr. F. L. Engledow, who explained the theory of experimental error; by Sir J. Russell, who described the technique of manurial trials; by Mr. W. H. Parker, whose subject was the technique of variety trials; and by Mr. R. G. Hatton, who spoke on the technique of fruit experiments. The meeting place afforded those present

an opportunity of familiarising themselves with the educational and research work now carried on at the University to an increasing degree; the work of the School of Rural Economy was described by Mr. C. G. T. Morison (in the absence through illness of Prof. W. Somerville), that of the Institute of Agricultural Engineering by Dr. B. J. Owen; and that of the Institute of Agricultural Economics by Mr. C. S. Orwin. Further variety was introduced into the proceedings of the conference by Prof. T. B. Wood, who dealt with recent work carried out by the Animal Nutrition Institute, Cambridge University, on the nutrition of the pig; by Mr. G. D. Amery, whose subject was early agricultural literature; and by Dr. J. A. Hanley, who addressed the conference on grassland improvement. Excursions were arranged having both an agricultural and an everyday interest, the former including visits to the Kelmscott herd of dairy shorthorns and the University Farm—where the work of the Agricultural Engineering Institute was illustrated: and the latter, visits to the Morris works and the University Press, as well as to different colleges.

In opening the conference the Minister of Agriculture (the Rt. Hon. E. F. L. Wood, M.P.), referred to the distinguished men such as Lord Ernle, Sir Daniel Hall, Mr. F. D. Acland —whom Balliol College had contributed to the agricultural world. He pointed to the increasing importance of Oxford University as a centre of agricultural education and research, possessing as it did, not only the teaching centre at the School of Rural Economy, presided over by Professor W. Somerville, but also the Research Institute in Agricultural Economics, directed by Mr. C. S. Orwin, and that in the Agricultural Engineering, directed by Dr. B. J. Owen. He thought it was true to say that the economics of agriculture which had hitherto been the Cinderella of agricultural investigation were at last attaining to their rightful place in research, advisory and educational schemes. He hoped the conference would become a periodic event and an integral part of the organisation of educational and advisory work. Research, advisory and educational work in agriculture was very fortunate in one respect—it enjoyed the support of all political parties. It was noticeable that whenever agriculture had been subject to review —as had very frequently been the case in recent times—the importance of education and research had always formed one of the principal recommendations made. That was a great source of strength.

It was sometimes asked why the Ministry did not make County Authorities move more quickly in agricultural education. Those who put this question forgot that while the Ministry had a great share in the organisation by providing the sinews of finance, the work depended for its success on an effective spirit of partnership between the Ministry and the County Councils; and if the principle of local autonomy were superseded the ultimate interests of agricultural education would not be promoted.

It was, further, not always realised how very new the research and educational system was. It was really only a six years' old child, since although the outlines of the system and, in some cases, rather more than outlines, existed previous to 1914, nevertheless organisation as we now see it was in the main the work of the post-war period. In the last completed year previous to the war, the total amount spent by the Ministry on the maintenance of agricultural research was £32,000: this had now risen to £260,000, and the total expenditure by the State on agricultural education and research in the present financial year was estimated at approximately £650,000. This figure was not quoted on the theory that efficiency and improvement were synonymous with expenditure; on the other hand, it could not always be compared favourably with the expenditure of other countries in this direction. But it did show that since the war the Government had given much assistance to the development of agricultural education and research; and considerable progress had been made.

The whole of this system rested on the county agricultural organiser as the foundation. He had first of all the function of teaching the sons and daughters of agriculturists, and next, what was perhaps more difficult, that of advising and educating the adult farmers on methods of improving their farming practice. He (the Minister) had always felt that there was something of a gap between the research and scientific work that was going on and the ordinary working farmer. In considering methods of bridging this gap, he thought that not much could be learnt by reading; more could be learnt by hearing; and nearly everybody could learn by seeing. The practice of sending the farmer leaflets and literature was good in its way, but was not so effective as arranging lectures or discussion societies; and the best practice was that of demonstrations. He was quite sure that much would be achieved by this last method.

The Minister concluded by expressing the hope that as a result of the bringing together in such conferences of a great variety of thought, ideas and experience, agricultural organisers, advisory officers, research workers and others would be led to feel that they were partners working together in a common business to which all would be enabled to make a contribution of increasing value.

The conference was an undoubted success; among the many results it is only possible to refer here to two. In the first place it was made abundantly clear that yield figures obtained from trials in which no provision was made for adequate replication of plots could not be expected to give a fully reliable measure of the value of any given treatment, owing to the extent of the experimental error involved; that such trials were nevertheless of value for demonstrational purposes when the known value of the treatment was so great as to be many times larger than the experimental error, or when the object of the work was to bring out points other than yield—*e.g.*, difference in plant characteristics: that for reliable results to be obtained from field experiments replication and "careful randomisation" of plots is necessary; and that results cannot be regarded as significant unless the differences in yield of plots under treatment from control plots are at least three times the probable error.

In the second place the value of the conference in bringing together the general practitioners of agriculture—the agricultural organisers—and the specialists—the advisory officers, was amply demonstrated. Each class of officer was assisted to realise the kind of problem to be solved, and work to be carried out, by the other class of officer: to realise also the fact that for the complete success of the scheme of advisory work among farmers the closest and most cordial relations between the two classes of officers are necessary. The conference seemed to show that there was every ground for believing that in almost all cases friendly relations have already been established, which cannot but be cemented by meetings of this character.

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Ouse Drainage Rates.

THE Ministry has now prepared a draft Order under the Land Drainage Acts, which, if confirmed, will provide for the temporary suspension of most of the rating in what are known as the upland areas of the Ouse Drainage District. It will not, however, provide for the exemption of these areas from rates

made before the Order comes into force. The Order also makes special provision as to the carrying out of works in the upland areas during the suspensory period.

A copy of the Order can be obtained free of charge on application to the Ministry's Office at 10, Whitehall Place, London, S.W.1.

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Ouse Drainage Commission.

THE Minister of Agriculture and Fisheries (the Rt. Hon. Edward Wood, M.P.), early in April appointed:—Sir H. C. Monro, K.C.B. (*Chairman*) (late Permanent Secretary to the Local Government Board), Sir John Oakley (past President of the Surveyors' Institute), Mr. W. J. E. Binnie (M.A., M.Inst.C.E., F.G.S.), and Mr. Leopold Harvey (Solicitor, Clerk to the Welland Drainage Board and other Drainage Authorities), as Commissioners to investigate the whole problem of the drainage connected with the River Ouse, with a view to advising the Ministry on the following points:—

(i) The nature and extent of the essential works required to put the Ouse Drainage System in a proper state and the estimated cost thereof.
(ii) The degree of benefit likely to be conferred on the various areas and sub-areas, into which the Ouse Drainage District is at present divided, by the execution of such works as are reported by the Commissioners to be so required.
(iii) The ability of the several areas and sub-areas respectively to contribute to the cost of executing such works.
(iv) The amount of Government financial assistance which would be essential to secure the execution of such works.
(v) The amendments of the Ouse Drainage Order necessary or expedient for enabling the Ouse Drainage District to be drained effectually.

The Minister had also appointed Mr. H. Meadows, of the Ministry, 10, Whitehall Place, London, S.W.1, to be Secretary to the Commissioners, and all communications should be addressed to him.

* * * * * *

Agricultural Research Exhibit at Wembley.

THE British Empire Exhibition is to be opened by His Majesty the King on 9th May, and the hope may be expressed that the Exhibition will prove a great success, both financially and as illustrating in some measure what the British Empire is and does. There will be much to be seen at the Exhibition which is of interest and importance to the general public, and certainly no visitor should miss seeing the British Government Pavilion, with its displays relative to agriculture, science, trade, health, housing, transport, the army, the navy, the air service and other items.

From the farmers' point of view the most attractive corner ought certainly to be the gallery of the Ministry of Agriculture, in which will be shown a representative collection of exhibits illustrating the problems dealt with by the independent agricultural research stations now financed chiefly by Government funds. The exhibits must be regarded primarily as research exhibits, but education is represented by means of a map showing the organisation of the country's agricultural institutions.

The exhibits cover a selection of subjects which attempt to outline, very briefly it is true, the story of research work which is being conducted at research institutions in England, Scotland and Wales. In order to make the exhibits even more intelligible and useful, a guide has been prepared in which an endeavour has been made to explain some of the main problems of farming, as these are represented by the soil and its treatment, farm and garden crops, live stock, land drainage, machinery, farm pests, and so forth.

The creation of the Development Fund in 1909 enabled the Departments concerned to frame a general policy of agricultural research, map out the work to be done and allot it to specially equipped institutions. With the funds which have since become available, it would be true to say that, although there is still a wide field for labour and for private munificence, there are now few agricultural problems likely to yield to research upon which some work is not being done.

In the selection, preparation and staging of the exhibits, the Research Institutions have undertaken the lion's share of the work, and to them are due, for this and for many other services, the thanks of the Ministry and of all who are interested in British agriculture. Full acknowledgment to each institution concerned is made in the official guide to the Agricultural Exhibit of the Government Pavilion, copies of which may be obtained, price 3d., post free, from the Ministry, 10, Whitehall Place, London, S.W.1.

* * * * * *

Farm Workers' Minimum Wages.

A MEETING of the Agricultural Wages Board was held on 25th March, at Gwydyr House Annexe, Whitehall, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from various Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and

proceeded to make the following Orders carrying out the Committees' decisions :—

Beds. and Hunts.—From 30 March (when the previous Order expired) to 31 Oct., male workers, 21 and over, 30s. 6d. for 50 hr., instead of 29s. for 48 hr. as at present. Female workers, 18 and over, increase from 5d. to 6d. per hr. Proportionate rates for younger workers and differential overtime rates, the latter in the case of adult male workers being 9d. per hr. weekdays and 11d. per hr. Sundays.

Essex.—Continuing the rates for male and female workers previously in force (which expired on 28 March) to 31 Oct. Male workers, 21 and over, 30s. for 50 hr. in summer (second Monday in Feb. to second Sunday in Nov.) and 48 hr. in winter (remainder of the year).

Hereford.—From 30 March to 30 April. Female workers, 18 and over, 4½d. per hr.; 15 and under 18, 3½d. per hr.

Norfolk.—From 30 March amending the existing Order so as to provide that the extra sum payable to workers under 18 employed as cowmen, bullock-tenders, and sheep-tenders and not in sole charge of animals be reduced to 3s. per wk., and that the clause guaranteeing payment for a week of 50 hr. in summer and 48 hr. in winter be restricted to workers employed by the week or longer period.

Sussex.—Overtime rates for all classes. Male workers, 21 and over, 9d. per hr. on weekdays and 10½d. per hr. on Sundays; female workers, 18 and over, 6½d. per hr. on weekdays and 7½d. per hr. on Sundays; lesser rates for younger workers of both sexes. The rates to operate as soon as practicable after the Sussex Agricultural Wages Committee have defined the employment to be treated as overtime employment.

Radnor and Brecon.—From 3 April (when existing rates expire) to 2 May (pending the fixation of rates for a longer period). Male workers, 21 and over, 31s. for 52 hr. in summer (1 Feb. to 31 Oct.) and 50 hr. in winter (rest of the year).

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

* * * * * *

Grants for Agricultural Research.

THE Ministry is prepared to receive, not later than 15th May, applications for grants in aid of scientific investigations bearing on agriculture to be carried out in England and Wales during the academic year commencing 1st October, 1925. The conditions on which these grants are offered are set out on the prescribed form of application (A.53/TG), of which copies may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, S.W.1.

THE RELATIVE PALATABILITY OF PASTURE PLANTS.

WILLIAM DAVIES, B.Sc.,
Welsh Plant Breeding Station, Aberystwyth.

IN view of the fact that the chief grasses and clovers are grown at the Welsh Plant Breeding Station both in mixtures and in pure plots, and that the plots are grazed by sheep kept under careful control, an excellent opportunity has been afforded for studying the seasonal palatability of herbage plants. The results recorded in the present article cover observations made during the whole of 1924 and during the first three months of 1925, and apply only to the preferences shown by sheep.* Arrangements are being made, however, to lay out plots at the College Farm (Nantcellan) in order to extend the scope of the enquiry to cover both cattle and horses.

The chief aims of the investigation have been to obtain exact information on the following points:—

(1) Whether selective grazing does in fact take place.

(2) Whether preference is due to some innate specific characteristic of the plants preferred, or whether selection is definitely seasonal—the plants being rather chosen for the succulency of their growth at any particular time than for any other apparent reason.

(3) Whether all the above-ground parts of plants are equally palatable or whether some parts are relished more than others.

Methods Adopted.—Fairly exact quantitative data were obtained on one experiment in particular (E.37) which consisted of pure plots, 1/100th acre each, of various nationalities of the chief grasses and clovers. Sheep were given access to the whole series of plots (duplicated for each strain) for a spell of days together at regular intervals of from ten to twenty days according to the amount of growth made, which was of course dependent on the time of year. Very careful observations were made both during and immediately after each grazing period, and marks (on a scale 0-10) were allocated to each species having regard to both the initial preference of the sheep and the extent to which they grazed particular plots throughout each period. Quantitative data were also obtained on a similar plan in the case of other pure plot experiments. In addition, accurate notes were made from time to time on three separate seed mixture trials, and on a number of trials designed to test winter and early spring productivity of various species, while in general

* For the most part Kerry Hill and Suffolk ewes and their lambs, Welsh Mountain sheep having also been grazed on some of the plots.

palatability notes have been taken after the sheep on all the enclosures and fields to which they have had access.

Discussion of Results.—The quantitative data obtained from the pure plots (chiefly E.37) are set out in detail in the table on p. 116. These data show that the sheep have exercised considerable selection, particularly during the summer grazing period, and also that in so far as individual species are concerned selection may be either—

(1) In favour of a particular species throughout the season, *e.g.*, red clover.

(2) In favour of a particular species only at certain growth periods of that species, *e.g.*, crested dog's tail.

Before discussing a number of interesting points that have emerged with reference to the whole question of palatability, it will be convenient to deal with the species separately, having regard to the evidence from all the trials under observation.

The Clovers.—It will be obvious from the results given in the Table that the clovers when regularly grazed are much sought after throughout the whole year, and that simple mixtures containing both clovers and grasses have a higher relative palatability than have the individual grasses contributing to such mixtures when grown on pure plots. There is, in fact, evidence for thinking that the grasses in a clover mixture are grazed with less discrimination and over a longer period in such mixtures than on pure plots. Observations made on the clover plots during May indicate that the more hairy types of red clover, notably American Mammoth, do not receive the same attention as average types, while the relatively hairless Bohemian red clover was undoubtedly relished more than any other strain.*

One reason why the clovers maintain a much more uniform palatability than the grasses is probably that under more or less constant grazing they never produce very much stemmy growth, but continue all the time to develop a relative abundance of fresh and succulent leaves,† while grasses like cocksfoot and Timothy produce a considerable amount of stem during May and June, perennial rye grass for an even longer period, and tall oat grass throughout most of the summer.

* It will be realised that a plant's grazing value depends on its productivity as much and sometimes perhaps more than on its palatability. It is not the purpose of this article to deal with productivity, thus a species or strain is not necessarily recommended for general use because it has been noted as palatable. The relative palatability of different strains of a highly palatable species may not be as important as would appear at first sight. In the case of red clover, for instance, if only one strain is employed in a mixture a relatively unpalatable strain would be likely to be grazed as heavily as a relatively palatable one.

† It is true that under pasture conditions some strains of red clover in particular develop a relatively large number of small flower heads, but these are not associated with a great deal of stem. See Williams, R. D., in Bulletin Series H. No. 3, of the Welsh Plant Breeding Station, pp. 131-150.

In the case of a series of red clovers allowed to grow tall and stemmy, and which were just commencing to come into flower before the sheep were turned on the plots, it was noted that the sheep preferred the tops of the stems including the flowering buds to even the leaves, thus, when plants are nearing maturity even the leaves lose their attraction for sheep. It is interesting to find that under the conditions of relatively hard grazing obtaining in connection with the trials under discussion, white clover has maintained a high and uniform attraction for sheep —Cockayne in New Zealand having noted this species as of relatively low palatability.*

Subterranean clover deserves special mention; observations made on a number of trials have shown it to be quite as palatable as red clover during the spring and summer months, while the long runners developed by this plant, especially in the young stage, are readily eaten by sheep. It differs from the other clovers in one very important respect, for as well as being highly palatable during the winter it is capable of making very decided winter growth, while observations made during January and February show that like Italian rye grass it is capable even during this period of making new growth fairly rapidly after being grazed.

Italian Rye Grass.—During the summer period this grass takes a lower place than would have been expected. This has, however, been partly, but by no means wholly, due to the position of the plots on the main experiment, which were slightly damper than those occupied by other species, the observations as a whole showing that the slightest tendency towards stagnation immediately reacts against palatability. Italian rye grass, however, being a very rapid growing grass produces a relatively large proportion of stem even during short periods of rest at the height of the growing season—the stem leaves are palatable enough to sheep, but the stems themselves are not readily taken when other leafy herbage is available, and this would largely account for the rather low summer palatability of this species. Italian rye grass is wonderfully green in winter and maintains a measure of leafy growth throughout the winter and early spring, during which period it is unsurpassed in palatability.

On plots which had been allowed to grow to practically the flowering stage before being grazed, Italian rye grass was decidedly more palatable than perennial rye grass, cocksfoot, and most other species, but probably because on the plots in

* Cockayne, L. "The Relative Palatability for Sheep of the Various Pasture Grasses." New Zealand Journal of Agriculture, Volume XVIII, No. 6.

question it had not attained to quite the same degree of maturity as the other grasses.

Perennial Rye Grass.—Perennial rye grass, though highly palatable during the winter, is slightly less so than Italian. It maintains a fairly uniform attraction for sheep during the summer, but when allowed to approximate to maturity is largely neglected.

Cocksfoot.—This grass takes a high place judging by the average figures. It is evident, however, that cocksfoot is only highly palatable when kept fairly closely grazed. In the summer sheep have entirely neglected plots approaching the hay stage, while in winter plots ungrazed became badly burned and relatively unpalatable. Cocksfoot properly grazed is not only of very high productivity, but of very high palatability during May and June.

Tall Oat Grass.—This species has taken a somewhat higher place, on the basis of the quantitative data, than might have been expected. This has, however, been largely due to the fact that the plots were kept closely grazed, for when tall oat grass is allowed to grow well into the stemmy stage it rapidly loses its attraction for sheep, and on plots in that stage was one of the last species to receive attention.

Timothy.—The high and well maintained seasonal palatability of Timothy to sheep has been a matter of some surprise, but has been borne out by all the trials. Being a late grass, if allowed to grow on without hard grazing until June, it appears to be very decidedly more palatable than cocksfoot, perennial rye grass or tall oat grass left until a similar date.

Meadow Foxtail.—Since meadow foxtail is a predominantly leafy grass it might have been expected to have been of high average palatability, but the data show that it is not relished by sheep to an outstanding extent at any period of the year. Field notes on other trials confirm this view. It is a grass which burns badly as the season advances, and towards the late autumn and winter the notes record cases where this grass had been left untouched whilst surrounding species showed evident signs of hard grazing.

The Fescues.—It is of interest to note from the figures in the Table that the fescues, broad and fine leaved alike, are not relished by sheep to the same extent as other grasses under observation. This has been very pronounced in the case of tall fescue, which although a very leafy grass has coarse harsh leaves which have proved relatively unpalatable. The seasonal notes have shown the plots adjacent to tall fescue, as well as the

Timothy drills which have separated the plots, consistently closely grazed, while the tall fescue itself, although showing signs of much trampling, was only lightly cropped.*

It will be noted that even early in the year when keep is very short, and when tall fescue relative to most other species is making good growth, its palatability is still lower than that of most species.

The Canary Grasses (*Phalaris nodosa and P. arundinacea*).—Neither of these two species appears to be relished by sheep when other herbage is available. When fodder becomes scarcer (after the end of July) the plants are, however, by no means discarded, and during August and September appear to attain to average palatability.† Later, *P. arundinacea* becomes very winter-burned and unpalatable. *P. nodosa*, although remaining fairly winter-green and moderately productive, is none the less of low palatability in January and February.

Crested Dogstail.—It will be noted that this species has taken a comparatively high place on average figures. It is of very considerable palatability to sheep except at the period which coincides with maximum flower production (late May and early June) when a very large number of stems are developed. The stems are not touched by sheep, and it is probably this excess of stems developed at the height of the grazing season which has been chiefly responsible for the low esteem in which crested dogstail is apparently held by numerous investigators.‡ There is little doubt, however, that crested dogstail should rank as an important pasture plant on fields open to sheep throughout the year, and particularly on relatively poor land.

Rough Stalked Meadow Grass.—This grass is highly relished by sheep during the winter period—although the growth is but slight, it remains very winter-green and is heavily grazed. This

* Evidence obtained on a semi-permanent pasture in Buckinghamshire would seem to suggest that both tall and meadow fescue are less palatable to milch cows than perennial rye grass and cocksfoot, for example. A 30-acre field which had been seeded out in two portions approximately 28 years ago recently came under the writer's observation. On one portion perennial rye grass and cocksfoot were the dominant grasses, while on the other portion dominance was shown by tall and meadow fescue. During the early part of the grazing season at all events the cattle showed a decided preference for the cocksfoot-rye grass area. The cattle evidence in this case thus appears to agree in detail with the sheep data given in the Table.

† Observations made during March, 1924, on one of the experimental fields of Mr Stanley M. Bligh, of Cilmery, Breconshire, confirm the above early season observations as to reed canary grass (*P. arundinacea*). A small area of this grass had been sown in drills on a field laid out with an ordinary mixture. The drills had made early leafy growth but had been entirely disregarded by the sheep although keep was decidedly limited at this period.

‡ See, *e.g.*, Johnstone-Wallace, D. B. "Experiments with seed mixtures in the North Riding of Yorkshire, 1921-23." Bul. No. 136 of the Univ. of Leeds and Yorkshire Council for Agricultural Education.

was particularly noteworthy during November on red clover plots in their third harvest year, in which rough stalked meadow grass had made a strong voluntary (indigenous) appearance. During the summer months, and especially at the time of active stem production, the grass is but little sought after, and this was particularly noteworthy during June.

Sweet Vernal Grass.—Observations on this grass confined to the early summer would indicate a species of very low palatability, and would further show the production of excess of flowering stems during this period. From September and onwards throughout the winter, sweet vernal grass, however, appears to be amongst the more palatable of the grasses to sheep.

Yorkshire Fog.—This grass was eaten by sheep to an appreciable extent all through the summer, but did not then compare favourably with the grasses like cocksfoot, Timothy or perennial rye grass. During the winter when keep was very scarce such plants as occurred as weeds on the plots were closely grazed. No pure plots were available for quantitative comparison with more orthodox species.

Miscellaneous Plants.—Observations were made in respect of a number of the commoner weeds of grassland, and the following notes with reference to the three most abundantly occurring weeds on the plots are of interest.

Daisies (Bellis perennis).—These herbs are not eaten to any great extent when other herbage is abundant, but during the winter months daisies appear to be extraordinarily palatable and much sought after by sheep. The leaves at this time are succulent and very winter-green and appear to be quite as, or even more, palatable than most grasses. Thus, during February probably the only grass that was as attractive to sheep as the daisy was Italian rye grass.

Rib grass (Plantago lanceolata).—Although eaten to some extent during the summer it was only in the winter that ribgrass compared favourably with the better grasses and clovers, but during this period it was not so heavily grazed as the daisies.

Buttercups (Ranunculus spp.).—The buttercups remained practically untouched even during the winter, although the leaves appeared to be succulent and were decidedly winter-green.

The Factors Influencing Palatability.—The observations as a whole have clearly indicated that palatability is influenced by a great number of variable factors, and it is desirable to consider the more important of these in some little detail.

Stage of Growth.—Speaking generally, the stage of growth of the individual plants appears to be the dominating factor affect-

ing palatability. It is the younger and more succulent growth offering on a sward that tends to receive the first and most sustained attention of sheep. Except in regard to comparatively few species, which are at all times more or less neglected, selection in the specific sense is only exercised by sheep to a marked extent during the late spring and summer period when keep is very abundant—at least this has been so in the case of the more heavily grazed swards under critical observation. At this period a number of secondary factors influence the palatability of any given species at any particular time. The following appear to be the most important.

The Relation of Leaf to Stem.—In the case of the grasses the sheep show an unmistakable preference for the leaf lamina as opposed to both leaf sheath and stem proper. The actual inflorescences of certain species of grasses in their young stages have a greater attraction for sheep than the stems bearing them, and sheep have been observed to graze the inflorescences of perennial rye grass and tall oat grass with apparent relish. In the case of pasture herbs like daisies, cat's ear and ribgrass, usually only the younger leaves are eaten, while the flowering shoots are almost entirely neglected.

Harshness to Touch.—It is probable that the chief reason for the neglect of tall fescue and to a less extent reed canary grass is the harshness of the leaves of these species, which would be at its greatest during May and June. It is probable that cocksfoot when approaching maturity is neglected for a similar reason.

Hairiness.—The relation of hairiness to the palatability of different strains of red clover has been mentioned, while extremely hairy plants like the buttercups and mouse-ear chickweed are but sparsely eaten even when keep is at its lowest during the winter. It is probable that the extreme hairiness of Yorkshire fog is the chief and perhaps the only reason for its relatively low palatability during the summer.

Habit of Growth.—The habit of growth of the grasses varies very much; the barren leaf shoots of different strains of the same species may be prostrate, erect or of intermediate habit. The two cocksfoots afford an excellent example—the indigenous plants are prostrate, the commercial more erect. Very careful notes taken after the sheep on both plots showed the erect growing commercial plants to have been more heavily grazed than the closer and more prostrate indigenous. Thus, although an excessively prostrate habit in grasses appears to be correlated with persistency, it would seem that strains possessed of such a habit are not necessarily the most desirable of pasture

plants.* It is noteworthy that although the leaves of daisies are highly succulent throughout the summer, the sheep do not appear to trouble to reach for the closely growing leaves of these rosette plants when an abundant grass leafage may presumably be taken with less effort. The effect of the habit of growth of a palatable plant in relation to that of other palatable plants was well seen in February in the case of a ley sown with Italian rye grass and extra late Montgomery red clover. At this period the clover was making practically no growth, and the green and succulent leaves present were covered by actively growing Italian rye grass, and it was the latter which was primarily taken by sheep until the sward was grazed excessively hard. The same type of phenomenon can be noted in respect of wild white clover in the summer on fields that are not over-stocked, or more strikingly still on fields which are considerably under-stocked. It will be noted, moreover, from the Table, that during June, July and early August the commercial mixture was more heavily grazed than the indigenous, and the observations made at the time suggest that this was primarily due to the more erect growth of the plants on the former plot, the leafage of which was, therefore, more easily accessible to the sheep.

Intensity of Grazing.—It will be obvious from the whole trend of the data presented in this paper that the intensity of the grazing must exercise a profound effect on the palatability of different species. Very heavy grazing even in May and June will afford less scope for selection than would lighter grazing during the same period. It is not therefore to be supposed that the various species would necessarily show the same scale of palatability as here recorded at another centre stocked on a different plan, where the whole conditions would be different, probably giving a somewhat different balance as between the growth stages of the several species at any given time. It must also be remembered that the extent to which a species will be sought for at any given time will in part be determined by the number and palatability of the other species to which the grazing animals have access.

The Seasonal Aspect of Palatability.—The grazing year, in so far as grass-sheep are concerned, may be divided into three main periods, namely:—early period (January-April): middle period (May-September); and late period (October-December).

Early Period.—This is the most important and difficult period of the year for the sheep breeder. Selection is shown by sheep

* The leafage of a prostrate strain of a grass growing in a mixture with erect plants tends, however, to be drawn up by the other herbage. In connection with grass breeding the relation of prostrate to erect strains with reference to both persistency and palatability affords at once an interesting and difficult problem.

at this period for those plants that remain winter-green, *e.g.*, Italian rye grass, perennial rye grass, rough stalked meadow grass and crested dogstail, and also later in the period for species which start growth earliest in the spring, *e.g.*, Italian rye grass and tall oat grass, thus emphasising the importance of the factor of succulency.

Middle Period.—This period covers the time of most abundant keep on pastures, and may be divided into three sub-periods :—Pre-flowering, flowering and post-flowering.

1. (Pre-flowering.)—The constituents of a pasture are in full flush of succulent growth at this time, and selective grazing is very keen. Some of the species of earlier growth, like tall oat grass, will have begun to produce fibrous stem shoots and will tend to be relatively neglected, while very late species like Timothy will not have started vigorous growth and will not be receiving full attention.

2. (Flowering.)—This period marks the time when stock will exercise the maximum of selection—the chief tendency, however, being to leave untouched fibrous, over-mature and stemmy elements. Trials conducted at the Station indicate that in the case of pastures grazed wholly by sheep it is a sound practice to run the mower over the fields at this period—this eliminates the stems and causes a flush of fresh and succulent growth.

3. (Post-flowering.)—The growth at this period is generally predominantly leafy, and the selection of species during grazing is less intensive than during the pre-flowering or flowering periods.

Late Period.—During October and early November plants with a good aftermath assume considerable importance, and thus Italian rye grass and tall oat grass are usually highly palatable at this period. As November advances, species that tend to burn badly, such as meadow foxtail and cocksfoot, become unpalatable and tend to be neglected.

It should be stated that pastures fairly well grazed during September and October burn less than those which are rested, and there can be little doubt that the practice of accumulating foggage for the winter is necessarily associated with a considerable amount of waste.

Plants in their seeding year cater admirably for this period, being fresh and succulent, but too heavy grazing of young leys during the first autumn and winter is, of course, not to be recommended. It is better to make special sowings of Italian rye grass, which will also afford valuable grazing during the early period.

The Relation of Palatability to Nutritive Value.—In a broad way sheep appear to be decidedly discriminating with reference to choosing nutritious herbage, in so much as they exhibit a decided partiality for the highly nutritious clovers, and in the case of grasses they show a preference for young and succulent root leaves, which, as Fagan and Jones have shown, are presumably more nutritious than older leaves or stem. It is, however, quite probable that this selection in favour of a nourishing ration is largely accidental and wholly a matter of palatability, for it has been shown that they tend to neglect meadow foxtail, a grass which appears to be of particularly high feeding value, while they exhibit an unmistakable liking for Timothy, which is by no means one of the most nutritious of grasses.*

Summary and Conclusions.—1. Certain species of pasture plants of generally accepted value, notably the clovers, are undoubtedly particularly palatable to sheep more or less independent of conditions or of season; while a few species, as for example tall fescue, appear always to be relatively unpalatable.

2. The chief factors influencing palatability would seem, however, to be the relative succulency of the herbage afforded by any particular species at any particular time, and this is largely due to the stage of growth of the plants.

3. The leaf lamina, particularly of young developing leaf shoots, is far more attractive to sheep than either leaf sheath or stem proper. In the case of some grasses, *e.g.*, crested dogstail, the stems are always neglected, while in the case of others the actual inflorescences are preferred to the stems.

4. The degree of harshness or of hairiness of the leaves, and the habit of growth of the plants, are secondary factors influencing palatability.

5. When the herbage consists of a number of species of about equal palatability, it will be those species the leafage of which is most easily accessible to the sheep, that is to say, which make the more erect growth, which will be chiefly grazed.

6. There are three main grazing periods during the year. The extent to which different species winter-burn has a marked effect on their palatability during the winter and early spring. During the height of the growing season plants left long ungrazed soon become mature and unpalatable.

7. Sheep will be selective in their grazing in direct proportion to the amount of palatable herbage available. The herbage is both most abundant and most varied in the early summer, when very considerable selection is exercised.

* See Fagan, T. W., and Jones, Trevor H., "The nutritive value of grasses as shown by their chemical composition." Welsh Plant Breeding Station Bulletin, series H. No. 3, p. 85.

The relative palatability of some grasses and clovers at various periods of the year, and the relative palatability for the year as a whole, are shown in the following table :—

(Marks given on a scale 0—10. 10=most palatable at time of observation.)

Species	1924						1925		Relative Palatability (Clovers 100)
	May 13th	June 1st	July 11th	August 5th	August 26th	Sept. 19th	Jan. 19th	Feb. 17th	
Red clover	10	10	10	10	10	10	10	10	100
Alsyke clover ...	10	10	10	10	10	10	10	10	100
White clover ...	10	10	10	10	10	10	10	10	100
"Hay" mixture (commercial) * ...	10	10	10	10	10	10	10	10	100
"Pasture" mixture (indigenous) † ...	10	8	9	9	10	10	10	10	95
Timothy (indigenous)	8	5	10	10	8	8	10	9	88
Timothy (commercial)	10	9	8	9½	8	9	10	9	
Cocksfoot (indigenous)	9	8	6	8	8	9	10	9	87½
Cocksfoot (commercial)	10	8	7	10	9	10	10	9	
Perennial rye grass (indigenous) ...	10	5	8	10	8	9	10	9	86
Perennial rye grass (commercial)	10	4	8	10	8	9	10	9	
Tall oat grass (indigenous)	7	5	7	9	10	9	10	9	84
Tall oat grass (commercial)	9	5	6	9½	10	10	10	9	
Crested dogstail ...	8	2	6	9	9	10	10	9	79
Italian rye grass ...	6	8	5	5	8	7	10	10	74
Sweet vernal grass	5	3	5	8	8	10	10	9	73
Rough stalked meadow grass ...	5	2	4	6	5	7	10	9½	61
Meadow fescue ...	4	1½	3	9	3	9	10	9	61
Meadow foxtail (indigenous) ..	6	5	4	5	4	6	7	9	57½
Meadow foxtail (commercial) ...	5	5	5	7	3	6	7	8	
Phalaris nodosa ...	1	1	2	7	8	8	4	6	41
Phalaris arundinacea	2	½	2	6	8	6	4	—‡	
Red fescue (Chewings)	4	2	3	4	1	2	4	8	35
Tall fescue (indigenous)	½	1	0	2	3	2	7	7	30
Tall fescue (commercial) ...	½	0	0	3	3	3	8	8	

*"*Hay" mixture (commercial)*

	lb. per acre
Italian rye grass - - -	2
Perennial rye grass - -	6
Cocksfoot - - - -	8
Timothy - - - -	4
English late flowering red clover - - - -	4
Alsyke clover - - -	1½
Wild white clover - - -	½
Total - -	26

†"Pasture" mixture (indigenous)

	lb. per acre
Perennial rye grass - - -	8
Crested dogstail - - -	6
Rough stalked meadow grass -	2
Montgomery red clover -	4
Wild white clover - - -	2
Total - -	26

‡ Dry stems only, on green foliage.

GRASS LAND IMPROVEMENT IN THE WEST RIDING.

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DURING the last few years attention has repeatedly been called to the need for lime in many parts of England; but the question of cost has always been recognised as a serious factor, and has undoubtedly prevented the extensive liming of, at any rate, poor hill land. In this article it is hoped to show that, in certain large tracts of the West Riding of Yorkshire, liming is an economic proposition, and that—particularly now that special facilities are offered by the Government to encourage co-operative liming—it might with great advantage become a more common operation in the district under consideration, and no doubt also in other parts of the country where similar conditions prevail.

The district to which the present remarks refer is a tract of some 1,100 square miles, with Skipton-in-Craven as its approximate centre. It is a hilly area, consisting mainly of rough pasture and moorland, intersected by the fertile valleys of the upper reaches of the Nidd, Wharfe, Aire and Ribble. Although in Skipton the average annual rainfall is 38 in., on much of the surrounding higher land it is considerably heavier.

Types of Pasture.—The two main types of geological formation are Millstone Grit and Mountain Limestone, the former lying mainly to the south-east, and the latter to the north-west. Between the tops of the hills—which on the Millstone Grit are covered with heather, and on the Limestone formation mainly with a thin and wiry carpet of fine fescues—and the rich valley soils, there lie extensive areas of unproductive rough pasture in which the first and most serious limiting factor is undoubtedly want of lime. These pastures fall naturally into two types, according to the predominant constituent of the herbage. The first is known in the district as "White Bent Land," and grows from 30 per cent. to 50 per cent. of mat grass or white bent (*Nardus stricta*), together with an admixture of sheep's fescue (*Festuca ovina*), heath bedstraw (*Galium saxatile*), field woodrush (*Luzula campestris*), and tormentil (*Potentilla tormentilla*). In the second type the dominant constituent of

the herbage is common bent (*Agrostis*, spp.), and this may conveniently be termed "*Agrostis* pasture."* With both types is associated a continuous fibrous mat of undecayed vegetable matter, which may vary in thickness from 1 in. to 3 in., and which is practically impermeable to all but the heaviest rainfall.

Botanical analyses* were made of typical examples of the improvement of such land by lime and, in two cases, by lime and slag. A summary of certain of the results obtained is given in Tables I and II. It should be understood that the botanical analyses and rental values for each case refer to different parts of the same field; the first being that of the original untreated portion, and the others the limed, or limed and slagged areas, as indicated under "Treatment."

It should be stated that the rental values, where these could be ascertained, were in some cases actual, and in others estimated either by the tenants or the owners.

Lime Requirement.—In regard to the amelioration of white bent land, draining, in some cases, must be the initial step; but it is very doubtful whether this would be an economic proposition at the present time. Of such white bent land as is dry, it may be briefly said that the application of lime is the usual mode of improvement; and it is a common belief in the district that basic slag applied to such land without a previous dressing of lime fails to evoke any response. This opinion was supported by several cases examined, where it was impossible to detect, either by the eye or by botanical analyses, any result from dressings of slag alone. In forming an estimate of the amount of lime required by the type of land under consideration, the quantity of fescue present is to some extent a guide. As the percentage of fescue in the herbage increases, that of white bent decreases; and in general it is found that less lime is required on land growing a considerable amount of fescue than on pastures where this grass is less conspicuous and white bent is more decidedly dominant. As a rule white bent land has a lime-requirement of not less than 40 cwt. of quicklime per acre, and in many cases this figure is far exceeded.

Suitable Dressings of Lime.—In former days, when good small lime was obtainable for 3s. or 4s. per ton, it was not unusual to apply as much as 10 tons per acre, and 8 tons was

* For fuller details see "Observations on the Improvement of Poor Pastures in the West Riding of Yorkshire," by J. C. and D. A. Lynn: *Annals of Applied Biology*, July, 1924.

a customary dose. With the disuse of farm kilns, and the rise in price, such heavy dressings are not likely to be used again, nor are they necessary. In this connection, however, it is interesting to note that lime has recently been produced on a Yorkshire farm at a cost of little more than 10s. per ton;* and there is no doubt that many of the farm kilns that have long been closed might with advantage again be worked. On average land growing 30-40 per cent. of white bent, 15-20 per cent. of fescue, and a conspicuous amount of heath bedstraw, field woodrush, and tormentil, 3 tons per acre of good lump lime may be regarded as an adequate dressing, if followed up when the roughness begins to break—which may be from two to four years later—with 10 cwt. of basic slag. By this method better results are obtained, and at less expense, than by applying a greater quantity of lime alone. In cases where small lime is used, 4, 5, or 6 tons per acre may be the necessary dressing equivalent to 3 tons of good lump lime, according to sample. That small lime varies considerably in composition may be gathered from the following analyses† :—

		Mountain Limestone.	
Oxide of Lime	88.51	75.52	59.59
Oxide of Manganese	1.28	1.24	trace
Oxide of Iron and Alumina ...	1.98	11.18	18.66
Insoluble material	5.64	8.18	11.45
Carbonic Acid	1.12	1.13	2.07
Moisture, etc.	1.47	2.75	8.23
Total	100.00	100.00	100.00

Cost of Liming.—In 1922, when the present investigations were carried out, good small lime was in most cases the most economical form of lime for agricultural purposes. Excellent samples were examined both at the kiln and in the process of distribution in the field, which had been on offer at 12s. 6d. per ton on rail, as compared with lump lime at 32s. and ground lime at 52s. At the present time, however, similar small lime is bringing from 16s. to 17s. 6d., lump lime 35s., and ground lime 45s.: and there is therefore little to choose on the score of economy between small and lump lime, either of these being preferable to ground lime. In cases where the cartage is heavy, however, lump lime, despite its greater price per ton, may prove cheaper than small lime on account of the smaller quantity required. To the cost of the lime that of labour and

* "Lime Burning on a Yorkshire Farm," by A. G. Ruston, B.A., D.Sc., this *Journal*, November, 1924.

† Leeds University Bulletin No. 107: "The Need for Lime on Yorkshire Soils." by Dr. J. A. Hanley.

distribution must be added; and while it is realised that these must vary considerably according to local circumstances, 10s. per ton may be taken as a fair average for the district, as rail charges over big areas are not incurred. Thus if 3 tons per acre of lump lime at 33s. per ton be applied, adding 10s. per ton for labour and distribution, the cost per acre amounts to £6 9s.; a further outlay of 30s. being required later when the land is in condition to receive slag. The total cost of the improvement thus amounts to £7 19s. Using 5 tons of small lime, in place of 3 tons of lump lime, the cost may be estimated as follows:—

	£	s.	d.			£	s.	d.	
5 tons small lime at		16	0	per ton	=	4	0	0	
Cartage and distribution ...		10	0	per ton	=	2	10	0	
10 cwt. basic slag	3	0	0	per ton	=	1	10	0	
				Total	=	8	0	0	per acre.

Thus, under ordinary circumstances, it appears to be immaterial which of these two forms is used at the present time.

Results on White Bent Pasture.—Rough white bent land responds but slowly to treatment, and the effect of the lime is sometimes not striking for three or four years. Frequently, however, close scrutiny will reveal some improvement in the second year, as evidenced by the breaking up of the mat, the greener appearance of the herbage, the decreasing prominence of white bent, heath bedstraw, and tormentil, and the presence of small clover plants here and there. On the other hand, such treatment on sound land, particularly if of the heavier type, will, when helped by judicious and skilful mixed stocking, maintain a state of fertility for as long as forty years. Occasional further and lighter dressings of basic slag will effectually prevent any deterioration from taking place.

As an example of the duration of the action of lime alone, reference may be made to Case B. Although in this instance the soil is by no means heavy the effect of lime is still very evident sixty years after its application. From information obtained, it is certain that little deterioration, if any, had taken place up to ten years ago; but latterly the soil has shown signs of becoming exhausted of lime once more, as indicated by the reappearance of such weeds as heath bedstraw, field woodrush, and sheep's sorrel (*Rumex acetosella*), the reduction of the percentage of clover and a tendency to mat-formation.

It is probable that the "lime alone" portion of Case A, Table I, is also beginning to revert. This portion was limed in 1874, and has thus remained in good condition for about fifty

Case.	Altitude.	Soil and Geological Formation.	Treatment.	Botanical Analysis, 1922. Leguminosæ.	Better Grasses.	Inferior Grasses.	Weeds and Bare Spaces.	Rental Value per Acre.
				per cent.	per cent.	per cent.	per cent.	
A.	600 ft.	Sandy loam overlying Millstone Grit. 2 in.—3 in. mat	None	Nil	16.3	63.4	18.7	5/-
			Limed 1874 (5 tons lump lime per acre)	17.5	30.0	37.7	12.0	15/-
			Limed 1874: Slagged 1922 ..	24.8	33.2	28.5	11.8	20/-
B.	600 ft. rising to 800 ft.	Light loam from gritty drift of Boulder Clay overlying Millstone Grit. 1½ in.—2 in. mat	None	Nil	14.0	46.2	39.8	5/-
			Limed 1862 (6 tons lump lime per acre)	5.7	36.8	37.9	18.7	?
C.	600 ft.	Gritty loam overlying Millstone Grit. 2 in.—3 in. mat	None	Nil	21.3	51.0	27.0	5/-
			Limed 1913 (5 tons small lime per acre)	31.3	41.5	16.2	9.8	25/-

TABLE II.—AGROSTIS PASTURE.

Case.	Altitude.	Soil and Geological Formation.	Treatment.	Botanical Analysis. Leguminosæ.	Better Grasses.	Inferior Grasses.	Weeds and Bare Spaces.	Rental Value per Acre.
				per cent.	per cent.	per cent.	per cent.	
G.	850 ft.	Heavy loam derived from Millstone Grit shale. 1½ in. mat	None	1.4	14.3	30.4	53.5	?
			Limed 1920 (2 tons lump lime per acre)	5.6	39.2	30.7	22.5	?
			Slagged 1920 (10 cwt. 38 °/o)	36.0	28.6	17.7	16.1	?
H.	850 ft.	Good loam overlying Limestone. 2 in. mat	None	.1	33.4	41.1	23.4	7/6
			Limed 1908 (6¾ tons small lime per acre)	29.7	42.5	18.8	7.1	22/6

years. As will be seen from the botanical analyses, a dressing of basic slag applied to the limed area in 1922 has not only checked any tendency towards deterioration, but has effected a big improvement. It is a common experience in this district that slag applied to land which has been limed many years ago produces an excellent result.

Profit Obtained from Liming.—It may be calculated that lime followed by slag will, over a period of 45 years increase the rental value of the pasture by from 10s. to 15s. per acre, per annum, for 40 years of that period; or from 9s. to 13s. 4d. for the whole. Reckoning the cost of treatment at 160s. per acre, and the interest on this sum at 5 per cent. per annum (*i.e.*, 8s.) it will be seen that, where the improvement is calculated at 13s. 4d. per acre, the profit according to the enhanced rental value is 5s. 4d. per annum; and where the improvement is estimated at 9s. the profit is 1s. The actual profits occasioned by the better grazing produced and its effect upon the stock will, however, be considerably greater than these figures indicate; and there is no doubt that, although there are areas of land difficult of access, where the labour involved is too costly to permit of profitable liming, there are also extensive tracts which can, at present prices, be economically improved.

Treatment and Results with Agrostis Pasture.—The treatment of Agrostis pasture is not so straightforward as that of white bent land. There are large areas of Agrostis pasture in the West Riding which, like white bent land, need lime, and will not respond to slag without it. On the other hand, there are numerous examples of the success of slag alone on such land (see Case G. Table II), and observations in the district tend to show that on certain types of Agrostis land heavier dressings of slag would probably give a satisfactory result where the customary 10 cwt. fails. Agrostis mats differ greatly not only in depth but in their constitution; and as to some extent the lime requirement varies accordingly, the latter is no doubt some index to the mode of treatment to be pursued. Where the mat seems sufficiently open in texture, or thin enough to allow water to penetrate, the probability is that slag will be successful. There are cases of Agrostis pasture where the mat is not thick, or not very dense, and the underlying soil is suitable, when slag may with confidence be advised. There are others where the mat exceeds 2 in. in depth and is tough and

impenetrable, when it may be stated decisively that slag will produce no result. Between these extremes many instances occur in which it is impossible, without experiment, to decide whether or not basic slag will prove successful; and in all such cases a safe method is to apply an initial dressing of lime and to follow it with basic slag two or three years later. Often as little as 1-2 tons of ground burnt lime, or 2-3 tons small lime, or 2-4 tons ground limestone per acre is a sufficient dressing to open the way for slag. Lump lime, if less than two tons per acre be required, is not recommended on account of the difficulty of even spreading.

In general Agrostis pastures are more amenable to treatment than white bent land, and rather lighter dressings of lime may be used. Except on the worst types where the mat is more than 3 in. in thickness (which are not common in the district under consideration) dressings of 2-2½ tons of lump lime, or the equivalent application of small lime, with a subsequent dose of slag, will be found sufficient.

It is interesting to notice (vide Case H, Table II) that fields on the Mountain Limestone formation frequently respond to lime as well as those on other soils in this district. Wherever there is a depth of more than 6 in. of soil, even though limestone may be the underlying rock, the herbage may show all the evidence of lack of lime.

The tenant in Case H found that since the application of lime his sheep, particularly the lambs, throve much better than previously; and that whereas before the improvement the field would carry only in-calf cows, it was now able to support cows in milk during the best months of the year. In view of the fact that such an experience is by no means uncommon in the district, it is interesting to speculate as to how far the addition of lime to impoverished soil affects the lime content of the herbage, and ultimately influences animal metabolism.

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ENSILAGE.—VI: THE CHEMISTRY OF SILAGE.

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THE unfortunate history of the earliest attempts to make silage in this country lends point to the contention that the successful inclusion of ensilage in farming practice must be based on an intelligent understanding of the changes which occur during the preservation of crops by this method. It will therefore be the endeavour of the writer in this article to deal with certain chemical and nutritional aspects of the silage question in as simple a manner as possible, avoiding, as far as is practicable, the use of technical phraseology.

The Changes which occur in a Crop during Ensilage.—The changes which modify the character of a green crop during its conversion into silage are brought about by the operation of three factors :—

(1) *The Respiration of the Living Plant Cells.*—When the chaffed crop is filled into the silo, the cells of the plant material continue to live for some time, and their respiration activity leads to a portion of the carbohydrate of the crop (sugar, starch, etc.) being converted into carbon dioxide and water by combination with atmospheric oxygen. This change is accompanied by the production of heat, the latter being responsible for the familiar phenomenon known as self-heating in the mass of material. It is clear therefore that heating implies destruction of carbohydrate and the loss of important nutrient matter. The new electrical process for making silage seeks to obviate self-heating and the consequent loss of carbohydrate by causing the temperature of the chaffed fodder to be raised artificially to 50° C. (122° F.) by the passage of the electric current; at this temperature the plant cells die and respiratory activity is no longer possible.

In view of the fact that respiration is an oxidative process, it follows that the extent to which the change occurs will depend largely on the supply of air remaining in the crop after filling into the silo. Thus, if the crop is comparatively dry, it does not pack so tightly and consequently more air is retained. In such a case, a relatively high temperature may be attained in the silo. A similar result will be obtained if the process of filling the silo is carried out in stages instead of continuously. On the other hand, the ensiling of an immature sappy crop, which

settles down compactly and thereby leads to a more thorough exclusion of air, is usually associated with a low temperature rise. These considerations are of importance in view of the influence of the temperature of fermentation on the quality and type of the resulting silage.

(2) *The Activity of Plant Enzymes.*—All fresh plant materials contain substances known as enzymes, which continue to act after the death of the plant cell and which are able to bring about a breakdown of the complex constituents of the crop in much the same way as the ingredients of a foodstuff are broken down during digestion. During ensilage, for instance, the protein constituent of the crop is acted on by enzymes and to an appreciable extent is converted into the same simple materials (amino acids) as are produced when protein is digested in the animal organism. It should perhaps be pointed out that these amino acids are for the most part neutral substances and are in no way responsible for the acidity of silage. The protein of the crop may therefore be regarded as undergoing, in part, a predigestion in the silo, though it is questionable whether any particular advantage attaches to this change from the point of view of nutrition. It is of interest to note in passing the claim put forward on behalf of the electro-silo, namely, that it enables the protein of the crop to be preserved in an entirely unchanged condition.

(3) *The Activity of Bacteria and Fungi.*—The production of organic acids is perhaps the most characteristic feature of the changes occurring in the silo. This is partly attributed to the incomplete oxidation of carbohydrate during cell respiration in an insufficient supply of oxygen, and partly to the action of micro-organisms on the carbohydrate of the crop. The organic acids which may arise during the conversion of a crop into silage are :—

(*a*) Acetic acid (the acid of vinegar, possessing a sharp acidic smell) ;
(*b*) Propionic acid (similar in properties to acetic acid) ;
(*c*) Butyric acid (contained in rancid butter and possessing an offensive smell) ; and
(*d*) Lactic acid (the acid of sour milk, possessing little or no smell, but having a sharp acidic taste).

(*a*), (*b*) and (*c*) are usually referred to as volatile acids, whilst lactic acid is termed a non-volatile acid. With sour silage, the lactic acid is present in smaller amount than the sum of the volatile acids, the latter being mainly composed of butyric acid. In nearly all cases of unspoilt tower silage, however, lactic acid is present in excess, often very appreciable, of the volatile acids.

the latter consisting almost wholly of acetic acid. *In properly made tower silage, butyric acid should be entirely absent.* These features are brought out in Table I, which gives typical figures for the amounts of organic acids present in good maize silage.

TABLE I.—ACIDS IN MAIZE SILAGE.

	Per cent. of moist silage.
Acetic acid	0.41
Propionic acid	0.04
Butyric acid...	0.00
Lactic acid	0.89

Much work still requires to be done in regard to the elucidation of the factors which determine the course of fermentation in the silo. A promising line of investigation is suggested by the possibility of being able to bring about a desired kind of fermentation by inoculating the green fodder with preparations containing pure cultures of bacteria. Amongst a number of partially established results, one fact stands out as having been demonstrated with a fair degree of certainty, namely, that the fermentation is dominated by the lactic bacteria when the temperature in the silo rises above 50° C. (122° F.). Such a condition is unfavourable to the activity of other types of micro-organisms, and it is this consideration which explains the production of sweet silage in the stack and in the electro-silo. On the other hand, when only low temperatures are attained (as with succulent, immature forage) the course of fermentation is more uncertain, and sour silage, containing the offensive-smelling butyric acid, may result.

It cannot be too strongly emphasised, however, that the production of good silage may also be associated with low temperatures of fermentation, as is the case with two excellent types of oat and tare silage, namely, the green fruity and acid brown varieties. In the production of these types, however, due care must be exercised in ensiling the crop at the proper stage of maturity.

The foregoing account by no means exhausts the possibilities in regard to bacterial activity in the silo. It is recognised that the less resistant forms of fibre (cellulose) may be attacked and broken down by bacteria. Furthermore, where the temperature of fermentation is low, certain undesirable micro-organisms may become active and bring about changes of a putrefactive character, giving rise to ammonia and allied substances of a useless and sometimes harmful character. These changes are brought about at the expense of the valuable protein

constituents and their digestion products, and abundant evidence of such activity is obtained when sour clamp silage is submitted to analysis. In all types of unspoilt tower silage, however, the amount of ammonia is exceedingly small. Other fermentative changes may lead to the production of small amounts of fragrant-smelling substances which confer on the silage an extremely pleasant and palatable character. Such changes occur during the production of green fruity oat and tare silage.

Another interesting change, strictly chemical in character and possessing no nutritional significance, is that which concerns the chlorophyll constituent. As a consequence of the action of the organic acids arising during preservation, the green pigment is transformed into a magnesium-free pigment (phæophytin). Since the latter may exist in forms varying in colour from olive green to yellowish-brown and brownish-black, it follows that the colour of silage does not constitute a safe guide in regard to quality.

Before dismissing this phase of the subject, a word may be said on the subject of mould in silage. Spoiling by mould activity only occurs when air is permitted free access to the chaffed crop. In such a case the mass may become distinctly alkaline instead of acid and the material is thereby rendered unfit for consumption. In the tower silo, however, this type of activity only affects the surface layer, and good acidic silage is encountered at a depth of a few inches. In the making of stack silage, on the other hand, considerable wastage may occur as a result of mould action, especially if the stack be carelessly finished off.

Feeding Value of Silage.—The older literature on the subject gives the impression that silage necessarily possesses an appreciably poorer nutritive value than the green crop from which it is made. This impression still lingers in the minds of many farmers, who on that account are inclined to regard ensilage as a practice only to be adopted when it is forced on them by adverse weather conditions. Although the sour silage characteristic of the early attempts to make silage in this country undoubtedly possessed a feeding value decidedly inferior to that of the green crop, it is necessary to bear in mind that such material would nowadays be regarded as partially spoilt silage. There is every reason to believe that good tower silage is little, if at all, inferior in nutritive value to the green crop from which it has been made. Strong evidence in support of this view is afforded by the results of an investigation carried out

a year or two ago at Cambridge, when determinations were made of the digestibility of green oats and tares and also of hay and silage made from the oat and tare crop. The conditions of the experiment were so arranged as to make possible a fair comparison of the feeding values of the three types of fodder. Table II gives the results in terms of digestion coefficients. The reader should be reminded that the digestion coefficient of a given food constituent represents the number of parts of that constituent which are digested per 100 parts consumed. The silage was the green fruity type.

TABLE II.—DIGESTION COEFFICIENTS OF GREEN FODDER, HAY AND SILAGE FROM OAT AND TARE CROP.

	Green oats and tares per cent.	*Oat and tare hay* per cent.	*Oat and tare silage* per cent.
Dry matter ...	63.7	65.0	64.1
Protein ...	63.1	68.2	65.1
Crude Oil ...	51.9	36.8	73.4
Carbohydrate ...	76.5	71.3	70.5
Fibre ...	47.6	58.7	57.1

From the above data the following conclusions may be drawn :—

(1) The digestibility of the dry matter is of the same order in all three cases.

(2) There is no serious difference in the degree to which the protein of the three fodders is digested.

(3) The digestibility of the oil fraction is greatest in the case of the silage, though it must be remembered that the ether extract of silage is composed almost wholly of organic acids.

(4) The carbohydrates of the hay and silage are approximately of equal digestibility, and in both cases the digestibility is somewhat lower (but not to such an extent as was thought formerly) than that of the corresponding fraction of the green forage.

(5) The fibre constituents of the hay and silage are almost equally digested. but the fibre of the fresh green crop possesses an appreciably lower digestibility. This finding confirms the supposition that heating in the stack and in the silo leads to a definite increase in fibre digestibility. In view of the fact that such fodders contain large amounts of fibre, this increase of digestibility becomes of considerable significance.

If the productive values of the three fodders be calculated in terms of pounds of starch by the help of the digestion coefficients, it is found that the green fodder and silage possess almost equal nutritive alue, whereas the hay is slightly inferior to both. This slight superiority of silage over hay has been confirmed not only by measurements of the available energy stored up in the two feeding-stuffs, but also by the results of long-period feeding trials carried out on the University Farm at Cambridge.

Interesting results (as yet unpublished) have been obtained recently in connection with the digestibility of sweet rye grass and clover silage made in the stack. The dry matter was found to be only 47 per cent. digestible, and a notable feature of the results was the abnormally low digestion coefficient of the protein, namely, 12.2 per cent. The silage contained 4.28 per cent. of protein and it follows that the content of digestible protein was only 0.52 per cent. It was demonstrated beyond doubt that a big depression of protein digestibility occurred as a result of changes taking place in the stack silo, and a tentative explanation has been put forward which is based on a consideration of the abnormally high temperature attained in this particular stack (viz., 80° C.=176° F.). The fall in digestibility may have been due to the exposure of the protein of the crop to this degree of heat over a protracted period and if, in the light of future work the explanation proves correct, it follows that there is a two-fold reason why the temperature of the stack should not be allowed to rise much beyond the temperature requisite for the production of sweet silage (viz., 50° C.=122° F.). An unnecessarily high temperature implies undue destruction of carbohydrate and may further cause an appreciable depression of the digestibility of the protein constituents

Losses of Nutrient Constituents in the Silo.—From what has been said, it is clear that the ensilage of a crop must result in losses of nutrient matter (*e.g.*, carbohydrate), but that the residual silage, if unspoilt, need not possess, weight for weight of dry foodstuff, a feeding value much inferior to that of the green crop. In considering the losses which are incidental to ensilage, it must also be borne in mind that losses of a similar magnitude occur during the conversion of a green crop into hay. In Table III are shown the average results of several investigations into the changes which occur during the conversion of oats and tares into green fruity and acid brown silage.

TABLE III.—GAINS OR LOSSES IN SILAGE PRODUCTION.

	Green fruity silage. percentage gain or loss.	*Acid brown silage.* percentage gain or loss.
Dry matter	—11.2	— 7.7
Crude protein (including amides)	— 8.2	0.0
Crude oil (mainly organic acids)	+52.4	+45.0
Carbohydrate	—19.1	—14.7
Fibre	— 5.5	— 6.0
Ash (inorganic salts)	— 9.2	0.0
True protein (crude protein minus amides)	—41.0	—28.4
Amides (mainly digestion products of true protein) ...	+85.3	+96.0

The general significance of the data in Table III will be appreciated in the light of what has been written in the first section of this article. The figures bring out very clearly the essential differences between the chemical processes by which the two kinds of silage are produced. The loss of dry matter is greater in making the green fruity silage than that associated with the production of the acid brown type. This difference is largely a result of the more copious drainage which accompanies the ensilage of the less mature and more succulent crop, and further evidence of this is afforded by a study of the losses of crude protein and inorganic salts. Appreciable losses of these constituents occur in the production of green fruity silage, whilst with the acid brown variety the losses are nil. Conditions of immaturity appear to favour the splitting up of carbohydrate and true protein, and the figures for amides show that drainage away of juice must deprive the green fruity silage of substantial amounts of these soluble nitrogenous products.

The question of drainage from the silo is an urgent problem awaiting satisfactory solution. Work at Aberdeen has demonstrated that very large amounts of phosphates and lime and potash compounds may be lost as a result of juice drainage, and it follows that only by reducing the running off of juice to a minimum can the valuable inorganic constituents of the green crop be conserved. In this connection it is claimed that if a crop be ensiled in a concrete silo not provided with a drain, the expressed juice which would otherwise run off and be wasted is ultimately reabsorbed by the mass of silage. This points the way to the production of any type of silage with minimum losses, though it is not by any means certain that the retention of large volumes of acidic juice in this manner would affect the palatability of the silage beneficially. Furthermore, if the silage were used for stock at too early a date after filling, there might be a danger of the material in the lower part of the silo being very wet. The whole question of drainage from the silo is receiving attention at the present time.

The cutting of an oat and tare crop at a comparatively immature stage for the production of green fruity silage means not only bigger losses of dry matter during ensilage, but also the ensiling of a smaller weight of forage per acre than would be dealt with if the crop were cut at a maturer stage for acid brown silage. Against these considerations, however, must be set the fact that green fruity silage is distinctly superior to the acid brown type in regard to palatability, digestibility and

nutritive value, the feeding values being roughly in the ratio of 7 : 5.

As might be expected, the biggest losses of dry matter are associated with the production of sour silage. In the making of sour clamp silage from oats and tares, a 20-25 per cent. loss was measured, this figure representing the combined effects of fermentation and drainage and not taking into account actual wastage by spoiling. The smallest loss hitherto recorded in the Cambridge investigations was a 5 per cent. dry matter loss during the conversion of sunflowers into silage. The latter, however, was of a fibrous and woody nature, and on that account was little relished by stock.

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RATS.

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By far the most injurious animals in Britain are the rats, and in spite of the energetic measures taken to reduce their numbers they remain a very serious menace. They destroy enormous quantities of stored food, and spoil much more than they destroy; they do great damage to property by burrowing and gnawing; and they are vehicles of several formidable diseases. They multiply prodigiously, and there is probably one rat at least for each member of our population. They are continually being introduced afresh from foreign countries.

The Black Rat.—Neither of the rats now represented in Britain can be called a native. Both are aliens from the East, and the first to come was the Black Rat (*Rattus rattus*), whose arrival in this country dates from the time of the Crusades. In the Mediterranean region and in the East it is represented by varieties of a much lighter colour. Thus the Alexandrine variety, frequenting Asia Minor and North Africa, is brownish-grey on the back, and the Roof Rat of the Mediterranean region has the same part of its body yellowish- or reddish-brown. It seems that the black dress was acquired after the originally light-coloured *Rattus rattus* got a footing in colder countries, but it

must be kept in mind that many of the "Black Rats" (*Rattus rattus*) in Britain are actually brown, and many of the "Brown Rats" (*Rattus norvegicus*) are black. This is a source of frequent confusion, and shows that little importance can be attached to the colour until the species has been identified on other grounds, to be referred to later. For many years the black rat was a serious pest in Britain, as in Europe generally, not only because of its destructiveness but because it harboured the microbe of the plague (or Black Death). In the early eighteenth century, however, its rival the brown rat was introduced, and within fifty years this newcomer had prevailed. About the middle of the nineteenth century the black rat was a great rarity in Great Britain. In several places, *e.g.*, at Yarmouth, it has become common again, being introduced afresh by ships. Its climbing powers favour its prevalence as a ship rat, and in this respect it is more successful than its cousin.

The Brown Rat.—The original home of the Brown Rat (*Rattus norvegicus*) is in temperate Asia, and wild forms are still abundant in the region between the Caspian Sea and Tobolsk, and also to the west of Lake Baikal. It has become closely associated with man, and has been his shadow wherever he has sailed. It was not known in Western Europe till 1716, nor in Britain before 1728. The colder the country the closer is the dependence of the brown rat on man.

Darwin referred to the internecine struggle for existence between the brown rat and the black rat, which resulted in the latter becoming almost extinct in Britain. But four points must be kept in mind: (1) the brown rat is the hardier species, more of an outdoor creature and indifferent to the wetness of sewers and the like; (2) the brown rat is more of a burrower, and therefore less baulked than the black rat by barriers of stone and lime; (3) the brown rat is a much more indiscriminate eater; and (4) it is more plastic and tamable, as is well seen in the behaviour of its albino derivative the "white rat." No doubt the two species will fight when they must, but it is too simple to say that the brown rat directly killed off the black rat in the struggle for existence. As Dr. Chalmers Mitchell says: "Each species has its different aptitudes, capacities and preferences, and each insinuates itself into the most suitable environment. Possibly the extension of sewers and drains in this country has been a major cause of the greater success of the brown rat." Moreover, we cannot forget that the black rat is becoming common again in some places.

How to Distinguish Black and Brown Species.

BLACK RAT (*Rattus rattus*).	BROWN RAT (*Rattus norvegicus*).
Smaller, of slim build, with sharp muzzle.	Larger, of heavier build, with blunt muzzle.
Ears large, naked, almost translucent, reaching or covering eyes when pressed forwards.	Ears small, hairy, thick, hardly reaching the eyes when pressed forwards.
Tail slender, at least as long as head and body.	Tail stout, never so long as head and body.
Pads on soles of feet relatively large.	Pads on the soles relatively small.
Many slender grooved bristles in the soft fur. Usually ten teats.	Grooved bristles fewer and more slender. Usually twelve teats.
Adult weight rarely over eight ounces.	Adult weight normally 14-17 ounces.

The two species are nearly related, but they differ through and through—even in the crystals that form when their blood is dried. There are marked differences in the skulls and teeth, but to appreciate these requires some apprenticeship. For details we refer to M. A. C. Hinton's "Rats and Mice," in the British Museum Economic Series, 1918, price 1s., a very satisfactory guide. We must notice again that no reliance can be placed on differences in colour; and that differences in size and weight cannot be much utilised unless one knows that the contrasted animals are of the same age. A brown rat of thirty ounces is not uncommon, and one of 2 lb. 12 oz. has been recorded.

There should be no possibility of mixing up either of the rats with the Water Vole (*Arvicola amphibius*), badly called the "Water Rat." For the water vole is a heavily-built animal, marked by a broad head, a blunt muzzle, inconspicuous ears, and a tail with a good deal of hair. It is not infrequently found exploring in fields at a distance from the water.

Habits of Brown Rats.—Rats are most active in the darkness or semi-darkness. Their eyes can make much of dim light; and they have acute tactile sensitiveness in their whisker-hairs (or vibrissæ) and in their feet. They usually spend much of the day in their holes or burrows, resting and sleeping, and they often make comfortably lined nests. They often collect stores of food. In their coming and going in the open they make runs, which are marked by their spindle-shaped droppings. Their inclination to keep to these wonted paths makes trapping easier, but everyone knows of their suspicious wariness.

They are practically omnivorous, though vegetarian in wild conditions. The chisel-edged incisors are well adapted for gnawing, and part of the rat's activity in this direction, which

sometimes seems gratuitous, is necessary in order to keep the continuously growing incisor teeth from becoming too long. When the upper and lower teeth fail to meet properly strange overgrowths occur which sometimes end fatally. Rats may attack hard wood, lead pipes, bricks, and cement; but what they gnaw in such cases is not swallowed.

The brown rat is not such a clever climber as its cousin, but still it can do wonders. It is a better burrower than the black rat and is much more inclined to take to the water. It swims and dives well, and follows water-courses in spreading from place to place. Although it often lives among filth, it is by inclination a cleanly animal, and makes a habit of bathing whenever it gets a chance. There is often a spring movement of rats from human habitations to the open country and a return to shelter in autumn. There is often a vigorous hunting of small animals in the open and a not inconsiderable destruction of eggs and young birds. The seasonal movement is to be distinguished from trekking from one locality to another when overcrowding becomes intolerable, or when something occurs that makes flitting desirable. There are records of a unanimous departure from a haunt where the mortality from poisoning had been great.

Rats are sociable among themselves, though there is evidently an instinct which prompts them to kill and devour the maimed or weakly. Records of their "courage" in attacking man are probably misunderstandings, for the circumstances usually point to the desperate boldness of starvation. Moreover such abnormalities of appetite as attacking the feet of elephants are apt to seem stranger than they really are, for it is very improbable that it occurs to the rat that it is gnawing at the toes of a giant mammal! There is no doubt, however, as to the resourcefulness, ingenuity, and educability of rats. They form associations readily and they can learn in a short time to scamper through the passages of a Hampton Court maze.

Family Affairs.—Brown rats may be sexually mature when three and a half or four months old, and they can breed all round the year. The sexual season for a particular female extends for about nine months, and "heat" occurs at intervals of about ten days. The male is always ready to pair. The female cannot be impregnated except at the period of "heat," which lasts for only a few hours. The period of gestation is about three weeks, and the female is ready to be impregnated within a few hours of the birth of a litter. The average number in a litter is eight, but there are often a dozen;

and there may be five or six litters in a year. The female ceases to be fertile as she grows older—a fact sometimes overlooked in estimating the rate of multiplication. She is a careful mother, but in conditions of overcrowding, inadequate food-supplies, or captivity, she may devour her offspring. The young are born blind and naked, with their ear-trumpets sealed down. Their eyes open in about a fortnight and they are weaned in the course of their fourth week. It will be understood that many of the figures, such as the number of litters in a year and the number of offspring in a litter, vary greatly according to the conditions of life.

Numbers of Rats.—Two female rats kept in captivity are known to have had in 13 months 26 litters, amounting altogether to 180 immediate offspring. But the young would begin to breed in $3\frac{1}{2}$—4 months, so that the total number of descendants would be much greater. A common estimate is that a pair of rats, with six litters of eight in a year, would, with equal sexes and no deaths, be represented by 880 at the end of the first year. At this rate, there would be many hundreds of millions from a single pair and their descendants in the course of five years. Of course this never occurs.

Writing in 1918, Mr. Hinton started from the assumption that there were forty million rats in Britain at the beginning of the year, that is about one per head of the population and about one per acre of cultivated ground. He supposed that twenty millions had a chance of breeding, and that 95 per cent. of the breeding pairs died in the course of the year. He further supposed that 50 per cent. of the progeny died at birth, and that only half of the survivors had a chance of breeding, and that the young effective rats were subject to a natural mortality of 95 per cent. in the course of their first year. Even then, under suppositions so very unfavourable to the rats, the ten million pairs at the beginning of 1918 would be represented by 41,000,000 by December 31st. The cost of keeping them would be over £9,000,000, and the indirect loss entailed by their presence would be enormously greater. Mr. Hovell says that " it would not be surprising if the damage sustained by Great Britain, say in 1923, approached one million pounds sterling per week."

The Indictment of Rats.—To the farmer's interests rats are in many ways seriously hostile. They devour large quantities of grain and other foodstuffs, and foul even more. They attack root crops, and riddle stacks. They are hostile to pigs, poultry,

and pigeons. They do much damage to property, even to the extent of undermining walls. It is said that in 1909 alone £2,000,000 were spent in providing rat-catching or rat-killing apparatus.

But the indictment is still more serious when we think of rats in connection with disease. The blood of the rat often contains the microbe of the plague (*Bacillus pestis*), and this is disseminated by the rat-flea when the plague-stricken rat dies and the flea happens to pass not to another rat, as is usual, but to man. Even in these years of energetic action, the bacillus of bubonic plague occasionally occurs among black rats in British seaports. The dangerous Trichina worm, which causes trichinosis in man, is primarily at home in the rat. When a pig eats an infected rat it becomes trichinosed, and from the pig's flesh if it is imperfectly cooked the parasite reaches man. Mr. Hinton notes that in one instance the flesh of a single pig, escaping the watchful eye of the inspector, caused 337 cases of trichinosis, and of these 101 terminated fatally.

Another horror is that the dwarf tapeworm (*Hymenolepis nana*), which is very common in man, has the rat as its preliminary host. Rats are also said to disseminate a form of infectious jaundice. Rat-bite may cause a peculiar and serious fever.

Issuing from filthy places the rat may contaminate the food of man and beast with its germ-laden droppings, and there is reason to suspect that it is the vehicle of an intestinal disease (a kind of dysentery due to an amœba) that troubles man. The circle of the rat's life cuts man's at many points, and always inimically, except that it affords a convenient animal for experimentation.

Practical Measures Against Rats.—In many cases of animals that are hostile to man's interests, epecially when they become numerous, we can find some counteractive in carnivorous mammals and birds of prey; and there is no doubt that weasels and stoats, kestrels and owls, and some other creatures levy a useful toll on rats. Everything should be done to encourage these natural checks. But the rat menace in Britain has long since passed beyond being counteracted by the balance of nature. Millions of these pests are living under the shield of artificial conditions which favour their survival and increase. Yet the serious danger is being energetically faced, and there is no doubt that man can get the better of the rat as soon as he devotes adequate energy to the problem.

The preventive measures include the protection of foodstuffs in rat-proof receptacles; the rat-proofing of houses, stables, stores and stacks; the wiring of drains; the fumigation of ships and "rat-shielding" of hawsers with large circular discs; the replacement of wood by cement, concrete and brick in infested places; and, not least important, more careful disposal of refuse and reduction of the "crumbs," big and little, on which rats so largely feed.

The destructive methods are flooding, blocking, trapping, hunting and ferreting, the use of poisoned food (*e.g.*, with barium carbonate), and fumigating the holes and burrows with poison gas (requiring careful handling).

In regard to prevention and cure, we would make four general statements: (1) success in putting an end to a dangerous and disgraceful state of affairs will be in proportion to the unanimity of action all over the country; (2) mere reduction in numbers will not give more than temporary relief, if a substantial breeding stock is allowed to remain; (3) the extermination of mice should go along with the extermination of rats; and (4) no efforts are likely to be successful unless greater care is taken with the disposal of refuse and "crumbs."

See "The Destruction of Rats," Ministry's leaflet No. 244; "Rat Destruction: some Simple Suggestions," Ministry's Form No. 264/TK; "Rats: How to Exterminate them." Miscellaneous Publications of the Ministry No. 22, 6d., post free; E. G. Boulenger, "Report on Methods of Rat Destruction" (Zoological Society of London, price 6d.). A most admirable shilling's worth is Mr. M. A. C. Hinton's "Rats and Mice, as Enemies of Mankind," published by the British Museum, 1918. "Rats, and how to Destroy them" (Mark Hovell, London, 1924, pp. 465, 10s. 6d.). Attention should also be directed to the Rats and Mice (Destruction) Act of 1919, which makes it imperative on an occupier of land to destroy rats and mice and to protect the land from infestation.

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SPRAYING EXPERIMENTS AGAINST APPLE SCAB.

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IN the following article an account is given of spraying experiments against apple scab or black spot,* which were

* The Ministry's Leaflet 131, on Apple and Pear Scab may be profitably consulted by the fruit-grower on the subject of Apple scab and its control. Full information is given on such important practical points as the most susceptible varieties as well as the best fungicides to use to control the disease.

carried out during 1923 and 1924, in a commercial plantation at Egerton, Kent.* The trees sprayed were bush trees of the variety Bismarck, planted in 1915. These comprised four rows of one block, which also contained rows of Beauty of Bath and Lane's Prince Albert, and was situated at the west side of the plantation. The trees were planted at 14 ft. square, with black currants underneath. The rest of the plantation, separated by a narrow grass path, consisted of similar trees of the varieties Bramley's Seedling, Annie Elizabeth, Beauty of Bath, Newton Wonder, Worcester Pearmain, Cox's Orange Pippin and Lane's Prince Albert. The soil was a stiffish loam. The plantation had become rather weedy during the war, and pigs had recently been brought in to root up the ground in preparation for more thorough cultivation. The four rows of Bismarck were separated from each other by alternate rows of either Beauty of Bath or Lane's Prince Albert, which protected them from accidental spray drift. All the rows of Bismarcks had suffered severely from scab in 1922. They were moderately well-grown trees which had made a fair amount of wood-growth and had cropped reasonably well during the last few years. The yearly pruning had consisted of leader-tipping from a third to a half and lateral spurring to three buds.

The actual spraying was carried out with one bamboo lance fitted with the Drake and Fletcher " Mistifier " nozzle provided with the smallest nozzle-disc, viz., number 0. The spraying machine (Weeks and Son) was provided with a lead consisting of one 60-ft. length of rubber hose piping and the power was supplied by a small 2-h.p. Emerson Brantingham petrol engine, with a 50-gallon tank, design to be drawn up and down the headland by a light tractor. The spray was applied at a pressure of from 90-100 lb.; and, at the different sprayings, from $\frac{3}{4}$ to $1\frac{1}{2}$ gallons of the spray fluid were applied to each tree. All the spraying was carried out by one person† so as to secure uniformity of treatment for each tree.

As regards spraying materials, the chemical composition of the two brands of lime-sulphur used was found to be as follows:—Brand No. I, sp. gr. 1.302, polysulphide sulphur, 18.49 per cent.; Brand No. II, sp. gr. 1.194, polysulphide sulphur, 10.16 per cent. The lead arsenate paste (Swift's) was found to contain 16.12 per cent. total arsenic oxide

* We take this opportunity of thanking Captain R. D. Scoble-Hodgins for allowing us to carry out the experiments on his trees, and for kindly providing the necessary apparatus and labour.

† N. B. Bagenal.

FIG. 1.—Blossom trusses of Ecklinville showing the first outbreaks of scab on the earliest leaves at xx. This type of infection occurs on the variety Bismarck.

FIG. 2.—The entire crop of apples from the sprayed trees, showing result of grading the fruit.

No deduction can be made from this illustration as to any effect of the different sprays on yield, but their relative efficiency in controlling black spot may be judged by comparing the amount of fruit in Grade 3 (front row), Grade 2 (middle row) and Grade 1 (back row).

This is as follows :

	Gr. 3	Gr. 2	Gr. 1	Total
	lb.	lb.	lb.	lb.
Bordeaux - - - - - -	18	85	291	394
Lime-Sulphur and Arsenate of Lead	14	90	125	229

(As_2O_5), and 0.23 per cent. water-soluble arsenic (As_2O_5). The lime-sulphur used with the arsenate of lead paste was Brand No. II in 1923, and Brand No. I in 1924, and the manner of mixing the two constituents was as follows:—1 gallon of the concentrated lime-sulphur was mixed with 28 gallons of water, the further gallon—making 1 : 29—being used to make the lead arsenate paste—1 lb. 5 oz. (equivalent to 4 lb. lead arsenate paste to 100 gal. wash)—into a thin cream. The diluted lime-sulphur and lead arsenate were then mixed together and at once transferred to the spray tank.

The Bordeaux mixture was made on the formula:— 8 lb. copper sulphate, 8 lb. quicklime, 100 gal. water.

1923.—The first applications of the sprays were given on 23rd and 24th May,* when the trees were just out of flower. Since the trees had previously been found to be practically free from scab pustules on their young wood, it had been expected that at this date the various spray fluids could be applied to still quite healthy leaves to protect them from any subsequent infection. Such, however, was far from being the case. Inspection at this date showed that the scab fungus was already firmly established on many of the trees. The disease occurred sometimes as a few scattered spots of scab on some of the leaves, particularly those situated round the flower-spur, which are the earliest to appear in the spring. Not uncommonly, however, the leaves at the tips of the branches showed the disease, and in some cases these were so severely affected that nearly the whole upper surface of the leaf was uniformly black or sooty with the summer-spores of the fungus; in other cases the margins of the leaf had been attacked so vigorously that it was beginning to shrivel up.

The second sprayings were made on 15th June, under favourable weather conditions.

No spray injury to the foliage, of any economic importance, was observed. Some of the leaves of the trees sprayed with lime-sulphur showed an injury on the upper surface in the form of dark violet patches which were brown below; while many of the leaves (both young and full-grown) on the trees

* The lime-sulphur wash (Brand II) was applied on the morning of 23rd May, and the operation was finished at 1.30. Rain fell continuously from 2.30 onwards. It was concluded, from an examination made on 24th May, that the wash had dried on the leaves before the rain came, since these leaves were well covered with the dried spray-deposit.

sprayed with Bordeaux mixture showed the characteristic small reddish-purple spots. In no case did any shrivelling or leaf-fall result.

By 28th July a considerable number of small apples were to be found lying under the sprayed trees. The number under each tree was counted and the results tabulated. Owing to the fact that this fall of the fruit took place from some of the control trees also, and that the latter bore so little fruit, the data collected proved insufficient to allow of any inference being safely drawn as to whether the spray fluids used could

The trees used in the experiment produced but little fruit; all the apples were, however, graded. From the results shown in Table I, it is clear that all the fungicides used controlled the disease to a considerable extent. If the crop of the control trees be taken row by row, and compared with that of the trees in the same row sprayed with the various fungicides, it will be seen that the number of apples in Grade I, *i.e.*, apples entirely free from scab, is very considerably less—from 15 per cent. to 75 per cent. Comparing the relative efficiency of the fungicides used, Bordeaux mixture and lime-sulphur plus arsenate of lead applied to the trees in rows 2 and 4 controlled the scab better than did lime-sulphur, as shown by higher percentages of scab-free apples (averaging 70 per cent. for Bordeaux mixture and 77 per cent. for lime-sulphur plus arsenate of lead as against 47 per cent. and 40 per cent. for the two brands of lime-sulphur). With the trees of row 3, where the attacks of scab were less severe (the control trees giving 40 per cent. of apples in Grade I) the beneficial effects of the different fungicides used were approximately equal, the *increased* percentage of apples in Grade I, due to spraying, being as follows :— Bordeaux mixture, 24 per cent.; lime-sulphur plus arsenate of lead, 16 per cent.; lime-sulphur, Brand I, 16 per cent.; lime-sulphur, Brand II, 19 per cent. In row 1, the trees sprayed with lime-sulphur plus arsenate of lead gave 47.8 per cent. of apples in Grade I, and those sprayed with lime-sulphur, 45.2 per cent.; while the control trees gave 25 per cent.

While it was obvious that the amount of fruit graded was too small to allow of the relative efficiency of each fungicide being determined with accuracy, it seemed safe to conclude from the facts observed during the 1923 experiments that two post-blossom sprayings with any of the three fungicides, Bordeaux mixture, lime-sulphur plus arsenate of lead, and lime-sulphur, materially

increased the proportion of apples entirely free from scab (the increase varying from 15 per cent. to 75 per cent.).

1924.—The plantation was examined earlier than in 1923. On 1st May most of the leaves surrounding the trusses of flowers, which were in the advanced pink-bud stage (*see* Fig. 1), were more or less fully expanded. On several of the trees at this date the scab fungus was found on a few of the leaves surrounding the flower-spur. The fungus formed small, brownish blotches or spots (or more rarely dark lines about the midrib) on the under-surface of the leaf and usually near its tip (*see* × in Fig. 1). Most of the leaves which bore the spots of scab were situated by those flower-spurs which were nearest to the ground, but in one case the infested leaf was at a spur high up in the tree. On microscopic examination the scab spots were found to be producing thousands of summer-spores (*conidia*).

In many cases it could be seen that the leaf-tissue underlying the scab spot was brown and dead, suggesting that the infection must have taken place some days or weeks previously.

The question of the primary source or sources of infection with apple scab each season in fruit plantations may be briefly discussed here. Until 1924 the only stage known in this country in which the fungus persisted through the winter was that on the young (one-year-old) wood of certain susceptible varieties of apples. On the Bismarck trees used in the experiments, however, examination of the young wood during the winters of 1922-23 and 1923-24 showed that it was almost or quite free from scab pustules. In the same plantation, at a distance of about 75 yards, there were rows of Cox's Orange Pippin very severely affected on their young wood; and it is, of course, possible that summer-spores from the pustules on these trees may have been carried to the leaves of the Bismarck variety at the end of April, 1924, and started the disease there. A new fact, discovered in the early spring of 1924, however, indicated another very possible source of infection. The hitherto overlooked stage of the fungus was found, in which the spawn (*mycelium*) develops in the dead apple leaves during the winter and produces in the following spring fructifications containing winter spores. These spores, discharged into the air, may reach the young apple leaves and give rise there to the primary outbreaks for the season. This stage (which was well known in the other apple-growing regions of the world, but had not

previously been recorded for this country)* occurred commonly on dead scabbed leaves of the previous season in the plantation where the spraying experiments were carried out, and may well have accounted for the early appearance of scab on the trees.

The scheme of experimentation that had been planned was to supplement the two sprayings with the three fungicides used in 1923 with one additional earlier spraying, to be applied to approximately half the trees in each class, and to compare the results obtained from the two, and three, sprayings respectively. Fourteen trees were sprayed in each of the six classes, and eleven control trees were left unsprayed.

The bad weather, however, coupled with the fact that trees available for the experiments were strictly limited in number, made it impossible to carry out this programme. On 1st May, when the first application was attempted, the trees sprayed with lime-sulphur plus arsenate of lead received heavy rain before the spray fluid had dried on the leaves. The Bordeaux mixture, too, was applied under conditions which must have nullified its action, since heavy rain fell as soon as the operation was completed, and the spray on the leaves was in consequence greatly diluted, or possibly all washed off. The lime-sulphur wash, which was the first of the three spray-fluids to be applied, was the least seriously interfered with by the weather, and had probably become dry on most of the leaves before the rain came.

On 27th May, the second spraying was given to those trees which had been partially sprayed on 1st May, and on the same date the first spraying was given to the trees of the other plots. The weather was dry during the operation, with an overcast stormy sky, but occasional periods of hot sunshine.

On 9th June the sprayed trees were examined, and the incidence of scab on the leaves was recorded. The disease was described as "practically absent," if all the leaves were free, or if only one or two leaves showed a small spot of scab: as "slight," if the majority of the leaves were healthy while occasional leaves showed spots of scab: as "bad" when the

* A detailed account of this stage of the Apple Scab fungus was published in this *Journal*, vol. XXXI, Sept., 1924. It was there remarked: "Whether the formation of the winter-stage of the fungus takes place every winter in this country, or only in those winters (such as the last, 1923-4) characterised by dry, cold weather, can be determined only by future observations." It is of interest to note that, following the wet, mild winter of 1924-5, the winter-stage has again been found. Dead apple-leaves, collected in Kent and in Devonshire during February, 1925, were found to contain in abundance fructifications of apple scab with mature winter-spores ready to be discharged.

leaves on some of the branches were sooty, *i.e.*, the scab patches were so numerous that a conspicuous blackened appearance was given to the surface of the leaf; as " very bad " when sooty leaves were general. In Table II the amount of disease is shown, row by row, in all the sprayed plots, and on page 145 that on the control leaves is recorded.

Stonebridge Green Farm, Egerton; Spraying Experiments, 1923.

BISMARCK VARIETY.—Table I.

Spray fluid (applied twice)	No. of Trees in Experiment		No. of Apples picked	No. of Apples in Grade *			Percentage No. of Apples in Grade*			Weight of Apples	
	Row	No.		1	2	3	1	2	3	lb.	oz.
Bordeaux Mixture (8.8.100)	2 3 4	5 6 10	19 14 47	14 9 31	4 5 14	1 0 2	73.7 64.3 65.9	21.0 35.7 29.8	53 — 4.3	8 5 19	8 4 8
		21	80	54†	23	3	67.5	28.8	3.7	33	4
Lime-Sulphur, Brand II, 1 : 29 plus Arsenate of Lead Paste, 4 lb. to 100 gal. of wash	1 2 3 4	6 5 6 10	46 84 141 153	22 66 79 115	13 17 41 30	11 1 21 8	47.8 78.6 56.0 75.1	28.3 20.2 29.1 19.7	23.9 1.2 14 9 5.2	13 37 60 73	8 3 7 8
		27	424	282	101	41	66.5	23.8	9.7	184	10
Lime-Sulphur, Brand I; 1 : 29	2 3 4	4 3 5	23 70 41	10 39 23	8 25 12	8 6 6	38.4 55.7 56.1	30.8 35.7 29.3	30.8 8.6 14.6	7 26 17	12 8 3
		12	137	72	45	20	52.5	32.9	14.6	51	7
Lime-Sulphur, Brand II; 1 : 29	1 2 3 4	6 4 7 10	42 49 51 65	19 21 30 24	16 20 19 22	7 8 2 19	45.2 42.8 58.8 37.0	38.1 40.8 37.3 33.9	16.7 16.4 3.9 29.1	16 17 20 24	5 13 5 10
		27	207	94	77	36	45.4	37.2	17.4	79	1
Control (Unsprayed)	1 3 4	9 4 4	28 20 21	7 8 0	11 9 7	10 3 14	25.0 40.0 —	39.3 45.0 33.3	35 7 15.0 66.7	8 8 5	14 2 7
		17	69	15	27	27	21.8	39.1	39·1	22	7

* Grade 1: Entirely free from scab; Grade 2: Scab spots few or many but apple not too seriously affected to be unmarketable; Grade 3: Apple so cracked or disfigured by scab as to be unmarketable.

† 7.5 per cent. of these apples showed a slight "russeting," or discoloured blotches on the skin of the apple. Such apples, while marketable, would not be fit for fancy grade purposes.

TABLE II.

Spray fluid applied	Row	No. of Trees	Amount of Disease on Leaves on 9.6.24
Bordeaux Mixture applied twice	2	2	Slight to bad*
	2	3	Practically absent
	3	2	Slight to bad
	3	3	Practically absent
	4	3	Practically absent
	4	1	Bad
Bordeaux Mixture applied three times	3	3	Practically absent
	3	3	Slight to bad*
	4	8	Practically absent
Lime-Sulphur plus *Arsenate of Lead* twice	1	2	Practically absent
	1	1	Slight to bad
	2	4	Practically absent
	4	1	Practically absent
	4	1	Slight
	4	4	Slight to bad
	4	1	Bad
Lime-Sulphur plus *Arsenate of Lead* three times	1	3	Slight to bad
	3	5	Practically absent
	3	1	Slight
	4	4	Slight
	4	1	Practically absent
Lime-Sulphur twice	1	1	Slight
	1	2	Slight to bad
	2	3	Practically absent
	2	2	Slight
	4	2	Practically absent
	4	2	Slight
	4	1	Slight to bad
	4	1	Bad
Lime-Sulphur three times	1	1	Practically absent
	1	1	Slight
	1	1	Slight to bad
	3	5	Practically absent
	4	5	Slight to bad
	4	1	Bad

As the notes given in Table II indicate, spraying with all the fungicides used protected the leaves to a considerable extent from scab, which had then spread over the foliage of the unsprayed trees.

At this date it was observed that lime-sulphur did not control the disease on the leaves to the same extent as did Bordeaux mixture. On trees well sprayed with lime-sulphur it was not uncommon to find leaves where spore-producing patches of the scab fungus had spread and extended over the dried-on deposit of the spray. On the trees sprayed with Bordeaux mixture, the patches of scab were either dead or dying and no cases could be found where growth of the fungus was extending over the sprayed part of a leaf.

* One of these trees had a slight amount of scab on one side while on the other side, which was next to a control tree, the disease was bad.

A slight scorching of the tips and margins of a few leaves was noticeable on some of the trees sprayed with lime-sulphur plus arsenate of lead, as well as on some of the trees sprayed with lime-sulphur alone. On most of those sprayed with Bordeaux mixture, many of the leaves showed minute spots of a pinkish or purplish colour, due to spray injury. In none of the cases, however, was the injury severe enough to cause any economic damage, and no leaf-fall resulted.

On 24th June the last sprayings—second and third respectively—were given to the trees. The weather was hot, sunny and dry. Owing to the imperfect working of the engine, the different sprays were applied at varying pressure, particularly in the case of the Bordeaux mixture. The engine finally broke down completely, and 10 trees in the Bordeaux-sprayed plot were left unsprayed until 27th June, when the operation was completed in dry, sunny weather, using the Vermorel Knapsack Sprayer.

Table III.—Showing the percentage of "dropped" apples, 1924.

	Bordeaux mixture twice	Bordeaux mixture thrice	Lime-Sulphur Lead Arsenate twice	Lime-Sulphur Lead Arsenat thrice	Lime-Sulphur twice	Lime-Sulphur thrice	Control no spray
Number of trees - -	—	—	3	3	3	3	—
Number of dropped apples	—	—	50	387	172	636	—
Number of apples picked -	—	—	28	308	82	134	--
Percentage dropped - - -	—	—	64.1	55.7	67.7	82.6	—
Number of trees - - -	5	—	4	—	5	—	4
Number of dropped apples	14	—	39	—	81	—	10
Number of apples picked -	90	—	47	—	96	—	85
Percentage dropped - - -	13.5	—	45.3	—	45.8	—	10.5
Number of trees - - -	5	6	—	6	—	—	4
Number of dropped apples	135	221	—	359	—	381	188
Number of apples picked -	286	263	—	53	—	163	108
Percentage dropped - - -	32 1	45.7	—	87.1	—	70.0	63.5
Number of trees - - -	4	8	7	5	6	6	3
Number of dropped apples	12	120	339	355	352	738	128
Number of apples picked -	115	402	13	190	14	75	178
Percentage dropped - - -	9.4	23.0	96.3	65.1	96.1	90.8	41.8

On 24th July the plots were examined to ascertain whether any dropping of the fruit had occurred as a result of spraying. All apples, measuring from $\frac{3}{4}$ in. diam. upwards, found on the ground under each tree, were counted.* The number is given in Table III, together with the number of apples gathered from the trees at the final picking.

With regard to *Row 2*, it will be seen that the percentage of drops under the control trees was 10.5, and was practically the same as that of the trees sprayed with Bordeaux mixture (13.5), while the percentage rose to 45 with the trees sprayed with lime-sulphur alone or with lime-sulphur plus arsenate of lead. In *Row 3* there was a drop of 63.5 per cent. from the control trees, and 32 per cent. and 45.7 per cent. from the trees sprayed with Bordeaux mixture, while the percentage rose to 70 for the trees sprayed with lime-sulphur alone and to 87 with the trees sprayed with lime-sulphur plus arsenate of lead. In *Row 4* the drop from the control trees was 41.8 per cent.; from the trees sprayed with Bordeaux mixture twice and thrice, the percentage was respectively 9.4 and 23; with lime-sulphur twice and thrice, the percentage rose to 96.1 and 90.8 respectively; and with lime-sulphur plus arsenate of lead, twice and thrice, to 96.3 and 65.1. In *Row 1* (with no control trees) lime-sulphur, twice and thrice, gave 67.7 per cent. and 82.6 per cent., respectively, and lime-sulphur plus arsenate of lead, twice and thrice, 64.1 per cent. and 55.7 per cent.

It appears safe to conclude from the above figures that while the sprayings with Bordeaux mixture did not increase the normal percentage of drops from a healthy tree, the sprayings with lime-sulphur or with lime-sulphur plus arsenate of lead did induce an abnormal drop of the fruit to a very considerable extent. The increased percentage of drops due to spraying with these two fungicides cannot be exactly determined from the evidence available, owing to the variation shown by the control trees. The point must not be lost sight of that some of the drop from control trees may have been directly or indirectly due to very severe attacks of scab on those trees,† and that possibly the drop shown by the trees sprayed with Bordeaux mixture more nearly represents the normal from a perfectly healthy tree.

* For this process, a small handrake was used wherever grass and weeds were thick enough to conceal the apples.

† The development of scab was so plentiful on the majority of the leaves of some of the trees that they looked, at a short distance, as though soot had been thrown over them. Many of the leaves showed their margins curled under the effects of the disease.

There was some evidence to indicate that the percentage of drops from individual control trees increased in proportion to the intensity of scab attack.

The crop of apples in 1924 was very unequal on the trees in the plots, and not by any means heavy. The number of apples, the weight, and the condition of the crop as regards scab (which was graded as in 1923) are shown in Table IV.

It will be seen that the percentages arrived at, when the crop is graded by weight—which is more the commercial method of valuing a crop—approximate very closely to those obtained by counting the apples. This indicates that the average weight of the individual apple in all three grades was approximately the same. Fully-grown apples occurred not only in the scab-free grade but also in Grade 3, the unmarketable condition (see Fig. 2).

In *Row 2* the unsprayed trees gave 28 per cent. of the total number of apples picked, free from scab; the trees sprayed with Bordeaux mixture gave 66 per cent., and with lime-sulphur or lime-sulphur plus arsenate of lead, 70 per cent.

In *Row 3* the control trees yielded only 11 per cent. of apples free from scab; the trees sprayed with Bordeaux mixture averaged 73 per cent., with lime-sulphur plus arsenate of lead, 94 per cent., and lime-sulphur alone 90 per cent.

In *Row 4* the control trees gave 23 per cent. free from scab; the trees sprayed with Bordeaux mixture averaged 71 per cent., with lime-sulphur plus arsenate of lead, 58 per cent., and with lime-sulphur alone, 23 per cent.*

In *Row 1* certain spray fluids were compared against each other, with the following results :—Lime-sulphur plus arsenate of lead applied twice, gave 54 per cent. of apples free from scab, applied three times, 38 per cent.; lime-sulphur alone, applied twice, gave 45 per cent.; applied three times, 39 per cent. The sprays used appeared to control the scab which, according to the grading was undoubtedly present in this row to approximately the same extent. The relative efficiency of the two sprays was thus compared, although their *actual* efficiency in this particular row cannot be estimated in the absence of unsprayed trees.

* The different results obtained with lime-sulphur in Rows 3 and 4 is probably to be attributed to the difference of intensity in the attacks of the scab in these rows. In Row 3, where 89.6 per cent. of the number of the apples were scab free, the fungus on the leaves of all five trees, when examined on 9th June, was noted as "practically absent" (see Table II), while at that date the six similarly sprayed trees in Row 4, which gave only 17.3 per cent. of scab free apples, showed a severe infestation of the foliage (1 tree, "very bad," 5 trees, "slight to bad").

The main conclusion which can be drawn is, that as in 1923, all the fungicides used controlled scab to a considerable extent. Taking the averages given in Table IV, the control trees show only 21 per cent. of apples free from scab, and no less than 29 per cent. unfit for market; while with Bordeaux mixture (twice or three times applied) the averages are 74 per cent. and 73 per cent. of scab-free apples, with only 5 per cent. of apples unfit for market.

The curious fact that three sprayings with a fungicide gave in several cases less good results than with two, can only be explained by the supposition that the incidence of disease was greater on the trees sprayed three times, and that the unfavourable weather conditions prevailing when the extra (earliest) spray was applied to the trees, rendered that application ineffective.

Summary.—1. The scab fungus may occur on the leaves situated round the flower-spur of the Bismarck variety of apple before the blossoms open. In 1924 this primary infection of the leaves was well established by 1st May. It is most probable therefore that an application of a fungicide at the " pink bud " stage will be found of great value in controlling scab on Bismarck and certain other varieties.*

2. The variety Bismarck is extremely susceptible to scab on the fruit and also on the leaves, which may become sooty under the attack. The percentage number of scabbed apples on the unsprayed trees in the plots varied in 1923 from 100 per cent. to 60 per cent., and in 1924 from 89 per cent. to 72 per cent.

3. Spraying with any of the three fungicides, Bordeaux mixture, lime-sulphur and lime-sulphur plus arsenate of lead controlled scab to a marked extent.

4. None of the above spray fluids produced any serious scorching injury to the leaves or serious russeting of the fruit.

5. Some evidence was obtained which indicates that both the lime-sulphur wash and the lime-sulphur plus arsenate of lead wash may cause a dropping of the young fruit. No dropping was caused by spraying with Bordeaux mixture.

* This has been found to be the case in experiments on Bramley's Seedling carried out by the writers during 1924, the details of which will be published later.

Stonebridge Green Farm, Egerton; Spraying Experiments, 1924.

BISMARCK VARIETY.—Table IV.

…ray fluid	No. of Trees in Experiment		No. of Apples picked	No. of Apples in Grade			Percentage No. of Apples in Grade			Wt. of Apples	Weight (lb.) of Apples in Grade			Percentage Weight of Apples in Grade		
	Row	No.		1	2	3	1	2	3	lb.	1	2	3	1	2	3
…aux Mixture …lied twice	2	5	90	59	22	9	65.6	24.4	10.0	29	20	6	3	68.9	20.7	10.4
	3	5	286	229	51	6	80.1	17 8	2.1	84	67	15	2	79.7	17.9	2.4
	4	4	115	75	32	8	65.2	27.9	6.9	43	28	12	3	65.1	27.9	7.0
		14	491	363	105	23	73.9	21.4	4.7	156	115	33	8	73.7	21.2	5.1
…aux Mixture …lied thrice	3	6	263	173	79	11	65.8	30.0	4 2	93	62	27	4	66.7	29.0	4.3
	4	8	402	314	69	19	78.1	17.2	4.7	145	114	25	6	78.6	17.2	4.2
		14	665	487	148	30	73.2	22.3	4.5	238	176	52	10	73.9	21.9	4.2
…e-Sulphur …nd I +	1	3	28	15	10	3	53.6	35.7	I 7	12	7	4	1	58.3	33.3	8.4
…l Arsenate …lied twice	2	4	47	33	13	1	70.2	27.7	2.1	19	14	5	0	73.7	26.3	—
	4	7	13	8	4	1	61.6	30.8	7.7	5	2	2	1	40.0	40.0	20.0
		14	88	56	27	5	63.6	30.7	5.7	36	23	11	2	63.9	30.5	5.6
…e-Sulphur …nd I +	1	3	308	116	164	28	37.7	53 2	9.1	98	39	52	7	39.8	53.1	7.1
…l Arsenate …lied thrice	3	6	53	50	3	0	94.3	5.7	—	25	23	2	0	92.0	8.0	—
	4	5	190	105	72	13	55.3	37.9	6.8	70	40	25	5	57.0	35.9	7.1
		14	551	271	239	41	49.2	43.4	7.4	193	102	79	12	52.8	40.9	6.3
…e-Sulphur …nd I …ied twice	1	3	82	37	35	10	45.1	42.7	12.2	32	14	15	3	43.7	46.9	9.4
	2	5	96	67	25	4	69.8	26.0	4 2	41	28	11	2	68.3	26.8	4.9
	4	6	14	4	9	1	28.6	64.3	7.1	7	3	3	1	42.9	42 9	14.2
		14	192	108	69	15	56.3	35.9	7.8	80	45	29	6	56.2	36.3	7.5
…e-Sulphur …nd I …ied thrice	1	3	134	52	77	5	38 8	57.5	3.7	51	20	30	1	39.2	58.8	2.0
	3	5	163	146	17	0	89.6	10 4	—	63	55	8	0	87.3	12.7	—
	4	6	75	13	39	23	17 3	52.0	30.7	26	5	14	7	19.2	53.9	26.9
		14	372	211	133	28	56.7	35.8	7.5	140	80	52	8	57.1	37.2	5.7
…rol	2	4	85	24	46	15	28.2	54.1	17.7	26	7	15	4	26.9	57.7	15.4
	3	4	108	12	54	42	11.1	50.0	38 9	33	5	18	10	15.1	54.6	30.3
	4	3	178	41	86	51	23 0	48.3	28.7	60	13	30	17	21.6	50.0	28.4
		11	371	77	186	108	20.8	50.1	29.1	119	25	63	31	21 0	52.9	26.1

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DIPHTHERIA IN POULTRY (ROUP OR BIRD POX).

At the present time most investigators are agreed that avian diphtheria and bird pox are merely two forms of the same disease. It is also known under a number of other names, such as roup, diphtheria, diphtheritic roup, contagious epithelioma, chicken pox, contagious catarrh, canker, etc. It is very widespread, and is probably the commonest malady met with in adult fowls in this country.

Causal Agent.—This has been the subject of much research and has given rise to a great deal of controversy. It still remains a disputed question as to which of several particular agents described is the cause of the disease. The weight of evidence, however, points to the disease being due to a resistant filter-passing virus. Clinical evidence strongly supports the theory of a single virus, as the various forms may be observed in an infected flock at the same time.

Birds Affected.—Fowls and pigeons are particularly susceptible; it is seen frequently in turkeys, geese, ducks and guinea-fowl, and pheasants, quail and various wild birds may also be attacked. There is a great variation in individual susceptibility, young and well-bred birds being the least resistant, while some birds appear to have a natural immunity.

The immunity acquired from an attack of the disease varies in strength and duration. A severe attack produces a strong and lasting immunity, while a mild attack gives only a partial protection of short duration.

Flocks are most severely attacked during the autumn and winter months. In some outbreaks a small percentage only is affected and the death rate is low; in other cases the majority of a flock contract the disease, with a mortality up to 90 per cent. Factors which influence the mortality are the degree of exposure to infection, virulence of the virus, adverse weather conditions and insanitary houses.

Mode of Infection and Method of Spread.—Many of the conditions governing the route of infection are not fully understood. The virus is believed to gain entrance to the system either by an abrasion of the skin or by ingestion and to pass to the sites of predilection by way of the blood stream.

The disease is spread by direct or indirect contact of healthy and diseased birds, and may be carried by the hands, clothes or boots of attendants.

Symptoms.—The interval which elapses between actual infection taking place and the onset of the symptoms depends on the activity of this or that virus. It is generally from 3 to 12 days.

Three clinical forms of the disease are recognised :—

(1) Avian diphtheria, characterised by the presence of false membranes in the mouth.

(2) Bird pox, a diseased condition of the unfeathered parts of the head.

(3) A combination of the forms on the skin and mucous membranes.

(1) *Avian Diphtheria.*—The premonitory symptoms are dullness, loss of appetite, sneezing and an occasional hard cough. These are followed by a watery nasal discharge, which gradually becomes thickened and obstructs the nasal passages. The eyes are swollen, inflamed and discharge a viscid material which sticks the eyelids together. In many cases the head is swollen, on one or both sides, below and in front of the eye, due to an accumulation of exudate within the infra-orbital sinus. This condition is known as " one-eyed roup."

Owing to the obstruction in the nasal cavity breathing occurs through the mouth, and the passage of air over the tongue causes a drying and hardening of the tip and sets up the condition popularly referred to as " pip." The catarrhal symptoms are followed by the formation of false membranes in the mouth, throat and wind-pipe.

These false membranes are of tough, greyish or yellowish exudate which adheres very firmly to the underlying tissues, considerable force being required to detach them. The removal of the exudate leaves the underlying surface inflamed and ulcerated, and a new deposit is soon formed. The false membranes spread until eventually the whole of the mouth and nostrils are involved, and even the lungs and crop may be invaded. These deposits make swallowing difficult or impossible, barely sufficient air can be inhaled to support life, diarrhœa and emaciation occur from the absorption of toxic products, and death soon follows.

In acute cases death may occur from suffocation within a couple of days of the onset of symptoms from an accumulation of exudate in the opening of the wind-pipe. The duration of the disease, however, is usually from 2 to 3 weeks. Complete recovery may take place or the disease may assume a chronic form which lasts many months. When the eyes are involved

the birds become emaciated and die from starvation owing to their inability to see the food.

(2) *Bird Pox or Contagious Epithelioma.*—This form of the disease appears as warty-looking nodules on the featherless parts of the head, such as the comb and wattles, the eyelids and adjacent skin. In severe cases the lesions may spread over the feathered parts of the head and neck, outer surface of the thighs, and the points of the wings.

The lesions first appear as flat nodules, which increase in size until they attain the dimensions of a hemp seed or even larger; they have a tendency to coalesce into cauliflower-like masses. The nodules are firm, yellow in colour, gradually turning darker with age. When the lesions are confined to the skin of the head the health of the bird does not appear to be affected, and recovery usually takes place without treatment in 10 to 12 days.

(3) *Combined Form.*—The nodules on the head are often co-existent with diphtheritic lesions in the mouth and nasal cavity, and in such cases the mortality may reach 90 per cent.

Treatment.—When an affected bird is found, it should be isolated immediately. The healthy stock should be divided into small lots and the mouth and throat inspected daily. Birds showing the slightest signs of disease should be at once removed and isolated. The houses, fittings and utensils should be disinfected regularly during an outbreak. A minimum quantity of litter should be allowed, and it should be changed frequently. The drinking water should be renewed daily. The grain should be fed in troughs, and the use of dry mash hoppers discontinued. A separate attendant should be provided for sick birds; if this is impossible they should be dealt with last. The attendant should thoroughly disinfect his hands and boots before leaving the infected premises.

When only a small number of birds are affected, individual treatment may be carried out, with strict isolation.

The discharge should be removed from the nostrils by gentle pressure, and the nasal passages syringed out with a mild antiseptic solution. Suitable antiseptic solutions are 2 per cent. permanganate of potash, 3 per cent. boracic acid, or hydrogen peroxide.

The exudate should be removed from the eyes and 2 drops of a 20 per cent. solution of argyrol instilled into them twice daily.

Diphtheria lesions in the mouth may be treated with tincture of iodine after removal of the exudate. The opening into the

wind-pipe should be examined, and if any exudate is present it should be gently removed.

When a large number of birds are affected the best method of treatment is to submerge the head in a suitable antiseptic solution for a period of 30 seconds, keeping the mouth open and the beak elevated. This should be repeated twice daily.

Swellings under the eye should be freely opened and syringed out with an antiseptic solution until the contents are removed.

Prevention.—Infection may be introduced by the purchase of birds from infected flocks or by those returned from shows or laying tests. New purchases and returned birds should be isolated for one month, and examined frequently during that period, before being allowed to join the healthy stock.

The aim of every poultry-keeper should be the prevention rather than the cure of contagious disease; therefore, when dealing with the first few cases of an outbreak the policy of destruction is one which merits serious consideration. If the value of the affected birds is not great, it is both advisable and economical to destroy them and diminish the risk of virus accumulating and the disease spreading to the whole flock. The apparently recovered bird is always a possible source of infection, as it may have developed into a carrier of the disease.

In the majority of cases the effects of a severe disease, such as avian diphtheria, are never entirely eliminated. The bird remains weakened in constitution, and is likely, sooner or later, to fall a victim to some minor ailment which a more robust bird would easily overcome. The birds should be kept under good hygienic conditions, in dry well-ventilated houses and roomy runs.

Disinfection.—The virus is very resistant, and the most thorough measures are required for its destruction.

The first and most important part in the disinfection of an infected building is the thorough cleansing of the interior by scraping and sweeping. The droppings, scrapings and litter should be burned or mixed with quicklime and removed from contact with fowls.

The walls and roosts should be scrubbed with hot water containing caustic soda (10 per cent.) to remove all dirt and grease. This also acts as a disinfectant. The house may then be washed or sprayed with a disinfectant, such as 5 per cent. solution of carbolic acid, 2 per cent. solution of compound cresol, or 2 per cent. solution of formaldehyde. The infected runs should be top-dressed with quicklime at the rate of 2 tons to the acre, and.

where practicable, ploughed up and left vacant for six months. Dead birds should be burned or buried in quicklime.

Note.—Specimens for diagnosis may be sent to the Officer in Charge, Veterinary Laboratory, Ministry of Agriculture, New Haw, Weybridge, Surrey.

In the case of poultry a whole carcass should be sent, which should not be opened before despatch.

The name and address of the owner should be set out clearly on each specimen, and an explanatory letter sent by post to the same address.

Specimens must be packed in some waterproof material and enclosed in a box: otherwise the railway authorities may refuse to accept them.

The Ministry makes a charge for post-mortem examinations; for particulars see "Veterinary Tests for Poultry Diseases," this *Journal*, April, 1925, p. 81.

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APHIDES ATTACKING VEGETABLES AND MARKET GARDEN CROPS.

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A NUMBER of kinds of plant lice or aphides may be found from time to time feeding on vegetables and market garden crops. Whilst some of these are only of occasional or local importance, other are more or less general pests and must be regarded by gardeners and market growers as of considerable importance. This especially applies to the Mealy Cabbage Aphid (*Brevicoryne brassicæ*), the Black Fly (*Aphis rumicis*) on beans and the lettuce aphides (*Amphorophora lactucæ*, etc.). The measures of control are in most cases very similar, but where any special feature is prominent, such is referred to.

The Green Pea Aphid (*Macrosiphum pisi*, Kalt.).—This large green fly or aphid is often very harmful to main crop peas and sometimes attacks broad beans and sweet peas. Clovers, lucerne and trefoils are often heavily infested. In America it is known as the Destructive Green Pea Louse. In certain seasons we find on the tops of the peas a few large green winged females, with darker head and thorax. This generally occurs in late June or July. These winged females have flown from clovers, etc., and deposit living young on the peas—small green lice which rapidly grow into green wingless females which are viviparous. These wander about and after a few days commence to produce living young. Numerous generations of wingless females and now and then winged forms continue to appear on the peas right into the autumn, when a winged brood is produced which fly off to clovers, etc., and there give rise to

oviparous (egg-laying) females, which are wingless. Later, on the peas, a brood of winged males appears, which also fly off to the clovers, etc., and fertilise the egg-laying females. The latter deposit eggs which remain on the clovers till the spring, when they hatch and the young give rise to the queen aphids which produce many young asexually (without being fertilised). These continue breeding until June when winged females appear and fly off to peas and beans. Red clover is particularly attacked by this species. These insects also live on everlasting peas (*Lathyrus*, sp.) in gardens and hedgerows and on these the sexual broods also occur. The Green Pea Aphides when mature are very timid and readily fall if the bine is shaken. The insects smother the tender tips of the peas and kill them; they also attack the flowers and even the young pods in bad attacks; the latter become curled and stunted.

Treatment.—When a bad attack is taking place on staked peas much good has been done by shaking the insects off on to tarred boards; a feather brush has been used for this purpose by growers with much benefit, but it cannot be done with the dwarf varieties. Either spraying with soft soap and quassia or dusting with nicotine powder will also soon control this pest, the tender top growths being specially aimed at. Shaking off on to the ground and trampling the plant lice in is, however, usually sufficient.

The Black Fly (*Aphis rumicis*, Fabr.).—This aphis is in many years very harmful to broad beans and it now and then, in bad "blight" years, infests runner and French beans; wax-pod beans are also attacked. Unless it is dealt with at once, complete loss of crop may be the result. This species may be found on a great variety of other plants. It is frequent on the fronds of asparagus; it infests the tips of onions and may destroy the leaves; and it is also harmful to spinach and beet. It occurs in masses on docks, poppies, etc.; in some years it invades mangolds. It also winters on *Euonymus*, both wild and cultivated. It is especially beans that are attacked, notably broad beans.

The adult wingless female is black and dull, with paler legs and antennæ with dark markings; the young are deep green and the nymphæ have many white mealy patches. The winged female appears black, but the body is really deep green with black bars; the cornicles are black and the legs have pale areas.

The winged females settle on the tops of the broad beans just when they come into flower and produce living young. These soon grow into black wingless viviparous aphides which go on

reproducing until the whole of the tops of the shoots, leaves and stalks become smothered with them. The insects secrete much honey dew, which falls on to the leaves and blossoms. They increase in certain years so rapidly that they spread downwards and get on to the young pods and ruin them. The honey dew that falls down also does harm, first specking the leaves with brown spots, and the whole plant may die. In the summer a winged brood appears on the beans, etc., and these fly to other plants. Many go to mangolds, spinach and wild plants, and later in the autumn many to the wild and cultivated Euonymus and docks. On the Euonymus and docks sexual aphides occur and the oviparous females deposit their eggs. Many also live through the winter as adults on the everlasting Euonymus in gardens. The young coming from eggs on the docks and Euonymus develop several broods there in spring and then fly off to beans, poppies, etc., and so start the summer attack.

Treatment.—As this "blight" usually appears on a few broad beans here and there, and as from these primary colonies the blight spreads to the other beans, it is advisable to pinch off and crush all the "struck" tops. There is no doubt that ants spread this insect; the ants swarm over the colonies of black fly and one can watch them carrying females away to the tops of other beans. As the winged migrants from Euonymus, docks, poppies, etc., always settle on the tender tops, it is advisable to pinch off all the tops at the same time. Some growers prefer spraying; if this is done the spray should contain 6 oz. of nicotine to 100 gal. of soft soap wash. Other growers have used quassia and soft soap and reported success.

The French Bean Root Aphid (*Geoica phaseoli*, Passerini).—This subterranean plant louse is often very common on the roots of French beans and wax-pods, and also occurs on scarlet runners and occasionally on potatoes.

The wingless female lives entirely underground on the roots, it is more or less globular in form and of a bright yellowish-buff colour to almost white, and lightly covered with meal; the antennæ are very short. In the summer a winged brood now and then occurs. The winged females appear to place their young on the soil.

Beans that have been attacked can be distinguished by the plants flagging, especially in hot weather, and by their pale sickly hue.

Treatment.—When French beans, etc., are seen to be turning prematurely yellow and wilting it is well to pull up one or two and examine the roots and soil; if aphides are present they can soon be detected. Nothing can be done at that time that would

FIG. 1.—The Green Peach Aphid (Myzus persicae).
Alate viviparous female.

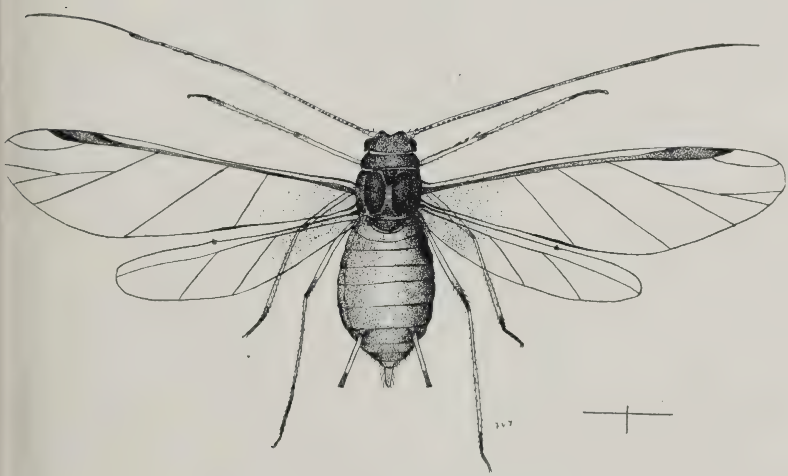

FIG. 2.—The Potato and Rose Aphid.
(Macrosiphum solanifolii).

FIG. 3.—Carrot split by Anuraphis tulipae.

Fig. 4.—Anuraphis tulipae.
Apterous viviparous female.

Fig. 5.—Brevicoryne brassicae.
Apterous females.

Fig. 6.—Brevicoryne brassicae
Alate females (Blakey).

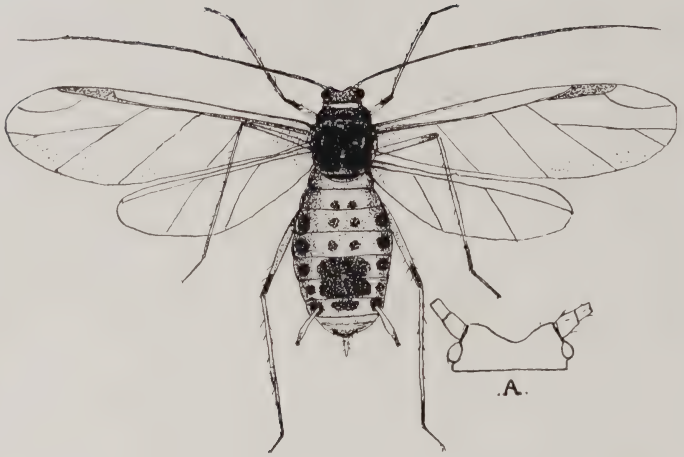

FIG. 7.—The Ribes and Lettuce Aphid. Amphorophora lactucae.
Alate female.
A. Head.

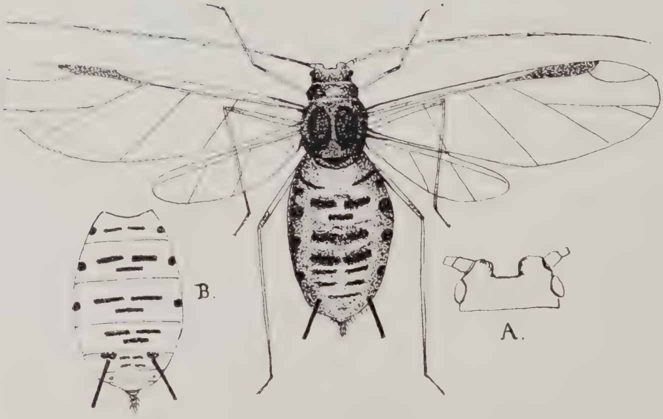

FIG. 8.—Myzus lactucae, or the Allied Ribes and Lettuce Aphid on Lettuce.
A. Head. B. On Ribes.

pay, but as soon as the beans have been gathered, the haulm should be pulled and burnt on the beds and the land dressed with naphthalene at 2 cwt. to the acre and dug in so as to prevent the winged aphides from attacking other plants.

Potato Aphides.—Four species of plant lice are found feeding on potato foliage, namely (1) the Green Potato and Rose Aphid (*Macrosiphum solanifolii*, Ashmead); (2) the Allied Potato Aphid (*Myzus pseudosolani*, Theobald); (3) the Green Peach Aphid (*Myzus persicæ*, Sulzer); and (4) the Small Potato Aphis (*Aphis solanina*, Passerini); and occasionally the Black Fly (*Aphis rumicis*, Fabricius).

The importance of these plant lice is not only that by their puncturing they damage the leaves, which in wet weather soon rot, but they carry the virus diseases of potatoes. This appears to have been proved in America and to some extent in Britain.

(1) *The Green and Pink Potato and Rose Aphid* is the largest aphid found on potatoes.

The wingless females are green or rarely pink, with long cylindrical green cornicles and long green pointed tail. The winged females are green or pink with darker head or thorax, long green cornicles, dusky at the tips, and long green tail.

The sexual forms occur on the rose and a few on potatoes, and eggs are laid there. In summer winged broods appear on roses and other plants, derived from the wingless females that hatched from the winter eggs, and fly to the potatoes and join others that have matured from the eggs laid on the potatoes at or after the time of lifting. This aphid occurs on plants under glass all the year, specially on tulips: out of doors it occurs on roses, beans, sow thistles, and many other plants. It never seems to be a serious pest on roses, but on potatoes and tulips may do much harm.

(2) *The Allied Green Potato Aphid.*

This aphid is somewhat similar in the wingless stage to (1), but the tail is shorter and the head is a different shape. It is green, yellowish-green or deep green, with rusty patches behind in some specimens; the green antennæ have dark bands and the green cornicles are cylindrical and have dusky tips. The winged female is green with dark transverse bars and lateral spots on the abdomen, dark head and thorax.

It is widely distributed over Britain and often occurs in great numbers. This insect attacks sprouting seed potatoes. When this occurs on seed stored in out-houses, etc., it flourishes and does much harm by killing the sprouts. If this seed is planted the aphides die but the seed produces a very much reduced crop. It also occurs out of doors.

(3) *The Green Peach Aphid* is a cosmopolitan insect and feeds in great numbers on potatoes. It is found on almost all plants except the conifers and broad-leaved trees.

It can at once be recognised by the fact that the cornicles of the wingless aphids are slightly swollen, and this is also generally the case in the winged forms; in the spring brood they may be cylindrical, but they are dark and not green. The wingless female is green, yellow or pale brownish-pink; cornicles the same colour as the body, dusky at the tips and slightly swollen in the middle. The winged female is green with dark head and thorax, two dark bars on the front, and a large dark patch behind, and behind that dark bars.

This insect lives almost all the year round and may be found breeding at all times under glass and indoors. It is very important as it attacks the sprouting potato seed.

(4) *The Small Potato Aphis* occurs under the leaves, but does not seem to do much harm to the plants directly.

The wingless females vary from green to dull brownish-green, but a few are almost yellow and some deep green. The much shorter antennæ and cornicles and its smaller size at once separate it from the other potato species.

Treatment.—Potato aphides may be killed by spraying with nicotine and soft soap, or quassia and soft soap, but dry spraying with nicotine seems best. It is only in bad attacks, however, that this is necessary. Seed potatoes certainly want attending to when aphides are seen on them. They are best put in closed boxes and fumigated with tobacco shreds, or if few in number may be dipped in soft soap and nicotine solution. This is very important as such attacked seed, if untreated, invariably produces poor plants and few tubers.

Aphides attacking Carrots and Parsnips.—Carrots are often attacked below ground by an aphid known as *Anuraphis tulipæ*, Boyer. The damage is done to the roots, the insects feeding on them and causing them to split. This cracking of course is often produced by excessive wet weather, but if this is the cause then the aphides are not seen.

The wingless ground form gives rise to winged females and males which come above ground at any time between September and December. The winged males appear in November and December. It also attacks bulbs of lilies, tulips, etc.

The subterranean wingless females are pale, covered with meal, and globular in form; there is much variation in colour, some being pale fawn to kid glove white, dull olive-brown, others olive-green to pale pink, with the sides and the thoracic segments often dusky. The dusky lateral marks may continue along all the segments; the last two segments are darkened; the cornicles are short and dark; the antennæ are shorter than the body. The winged female has a shiny brown to black head and thorax, with two pale bands between. The basal half

FIG. 9.—Gall of Pemphigus bursarius on Poplar.

FIG. 10.—Pemphigus bursarius on Lettuce Roots.

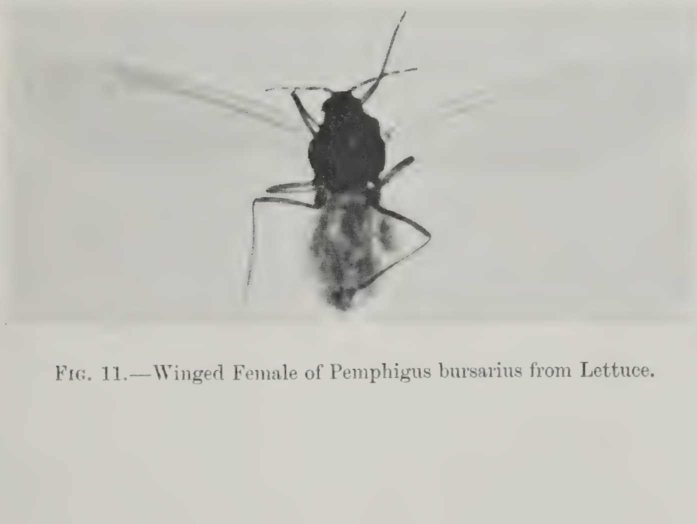

FIG. 11.—Winged Female of Pemphigus bursarius from Lettuce.

of the abdomen is pale ochreous to tawn, dull yellow to green, some tinged with pink; the remainder is black above; there are large black spots at the sides. The cornicles are rather short, black and cylindrical; and the legs are ochreous, with dark bands.

Willow Aphides (*Cavariella capreæ*, Fbr., and *C. pastinaceæ*, Sch.) also attack carrots and parsnips. Both these are found in summer on the leaves, but especially the flower heads of carrots and parsnips, and in some years do harm to the seed crop, the insects densely clustering on the flower heads.

Both are common on willow and osier leaves in late spring and summer, and about July and on into the beginning of August they become winged, when they migrate and settle on various wild and cultivated *Umbelliferæ*, where they flourish until the autumn. At the latter period winged forms appear and fly back to the willow, where the egg-laying females deposit their eggs. The forms on the *Umbelliferæ* may give rise to a winged generation, and these pass to other *Umbelliferæ* in summer, so that the cultivated carrots and parsnips may be infected from the related wild plants as well as direct from the willows.

Treatment.—Beds where carrots or parsnips have been attacked by the root aphid should be treated with naphthalene and at once dug in so as to kill the aphides shaken off in pulling. The foliage and seed heads when attacked may be sprayed with any well-known aphicide; this is especially important as the aphids may much reduce the seed crop.

Aphides Attacking Brassicæ.—*The Mealy Cabbage Aphid* (*Brevicoryne brassicæ*, Linn.).—No more objectionable sight can be seen than winter greens badly infested with aphis. The whole plant now and then becomes a sticky mass of mealy aphides, honey dew and excreta, and to make it more repulsive still there may be found crawling about amongst them the fat leech-like larvæ of the Hover Flies, predaceous insects trying to restore the balance of nature. Such attacked plants are ruined for market. In 1904-1905 this aphid was very destructive in Kent and Essex. In the Dartford district alone hundreds of acres were attacked and thousands of pounds lost. Again in 1911 it occurred in vast swarms, causing much loss in Dorset, Cheshire, Derbyshire and again appeared in countless numbers in Essex. In 1919 it was almost epidemic until November. In 1921 and 1922 it was exceedingly destructive and contributed materially to the shortage of winter greens. All manner of *Brassicæ* are attacked, as well as swedes and turnips, charlock, shepherd's purse, sea kale, etc.

The Mealy Cabbage Aphid is noticeable in May, when a few are found here and there on cultivated and wild *Brassicæ*. By

June they are more noticeable, there appearing on the leaves small pallid blister-like areas beneath which the insects shelter; later these patches become almost white. From July onwards, if the weather is propitious for the aphides, these gradually increase and smother both the upper and under sides of the leaves and stalks, until, as stated by Buckton, "Weight for weight there is more animal than vegetable substance present." All the worst attacks have been in the autumn and winter; the summer attack even if severe dies out or does not persist in such virulent form as the autumnal. Although all cultivated *Brassicæ* are attacked perhaps Brussels sprouts suffer most of all and cauliflowers least.

The wingless viviparous female is of a rather elongated oval shape, of a dull greenish-grey hue with two series of eight black spots on each side of the back; the legs, cornicles, eyes and the tips of the antennæ are deep brown. The body is covered with a white meal which quite hides the coloration. These females produce many living young, which are shiny green, but after their first moult the mealiness appears. From August onwards appear females, which have a dark head and thorax, and a dull green abdomen, with a row of seven dark patches in the centre and a row of four black spots on each side. These may unite to form continuous dark bands. The antennæ and the rather short cornicles are dark. The egg-laying females are wingless, pale green or greenish-yellow, with a row of black spots along each side of the abdomen and a double row of five dark patches along the centre.

The sexual forms appear in autumn and onwards into the winter. Some eggs are laid on and under the leaves, but mainly on the stalks. In swedes they are noticed to be mostly on the crown. One may find the eggs, viviparous forms and sexual forms all mixed up together. The leaves in November are sometimes blackened with the eggs. The eggs hatch in April and the young lice become stem mothers, which settle under the leaf and produce living young which surround them, forming small compact colonies.

Natural Enemies.—This species is particularly preyed upon by parasitic and predaceous enemies. Hover Fly or Syrphid larvæ feed ravenously on the masses of insects. Ladybirds, both adults and larvæ, do so to some extent. Many hymenopterous parasites attack them in the autumn.*

Treatment.—All old cabbage leaves and stumps should be burnt, thus killing thousands of the eggs and over-wintering insects. All cruciferous weeds should be destroyed near the beds or fields, as many eggs are laid on them and many living aphides

* For an account of such predaceous insects see *Beneficial Insects* (with two coloured plates), price 4d., from the Ministry).

may even over-winter there and be ready to infest the Brassicæ in spring and early summer. This especially applies to charlock and shepherd's purse. The disease often starts in the seed beds and if this is seen it pays to spray the plants and so prevent the insects from being taken to the fields. The most successful spray is nicotine and soap. If spraying is not done all seedlings showing signs of aphis should be discarded and destroyed. It is doubtful if spraying in the field would pay. When waste pepper was cheap it was used, mixed with road dust, for dusting Brussels sprouts, and it might even prove possible to spray sprouts, when seen to be attacked, with strong soft soap and water, if the market price at the time would allow. The destruction as soon as possible of cabbage stumps and old leaves is a most essential matter, especially if the plants have been badly attacked. The green peach aphid also attacks Brassicæ.

Lettuce Aphides.—Four kinds of plant lice feed on lettuce and endives, and in some seasons spoil them for market, as the insects breed rapidly in the hearts, making them obnoxious, and cannot easily be cleaned out even by much washing. The four species are (1) the Ribes and Lettuce Aphid (*Amphorophora lactucæ*), (2) the Allied Ribes and Lettuce Aphid (*Myzus lactucæ*), (3) the Dark Sow-thistle Aphid (*Macrosiphum sonchi*), and (4) the Poplar Gall and Lettuce Root Aphid (*Pemphigus bursarius*). The fourth attacks the roots.

(1) *The Ribes and Lettuce Amphorophora* is the worst of these plant lice. It is a common currant and gooseberry aphid, which in some years swarms on lettuces.

The wingless female on lettuces is shiny green to yellowish-green, and the green antennæ have dark bands. The tail and cornicles are green, the latter somewhat swollen; the yellowish-green legs have dark bands. The winged female on lettuces has deep brown to black shiny head and thorax, with a yellowish-green band in front of the latter. The abdomen is yellowish-green, with an irregular dark broken area on the posterior half, two pairs of small black dots in front and three large and one small dark lateral spot and a large patch at the base of each cornicle. The tail is pale yellow. The cornicles are yellow, swollen, and dusky at the tips. The legs are yellowish-green with dark bands. The winged female on *Ribes* is very similar, but the dark abdominal area is not quite so large and there are traces on the first two to four segments of sub-median dark spots. The wingless forms are very similar also but of a somewhat deeper colour.

This insect winters on *Ribes* in the egg stage, and breeds rapidly on them in some years, doing much damage. In late May and on to July the aphides become winged and fly off to the summer food plants, some settling on lettuces, others on sow-thistles and other plants. Winged broods are produced and fly

off and attack other lettuces, etc. Mid and late crops suffer most.

(2) *The Allied Ribes and Lettuce Aphid* also infests lettuce in a similar manner to (1) and also comes from currants and gooseberries.

It can at once be distinguished from the former by the cylindrical dusky cornicles in the winged female. The wingless female is yellowish-green to light green, some pinkish, and the abdomen has dark lateral spots. The cornicles are yellowish, dusky at the tips, and cylindrical. The tail is yellow. The winged female on *Ribes* has a shiny black thorax, with a green line each side and a pale band in front; the head is green; the abdomen shiny green to yellowish-green, and there are dark basal patches, etc., on the body. The cornicles are long, thin, cylindrical, black, and paler at the tips. The wingless female is much like that on the lettuce.

Like the former species it winters on the *Ribes* and leaves them in late May and June and flies off to the lettuces, sow-thistles, etc. There the winged females produce young and reproduction goes on all the summer. In the autumn winged return migrants fly from the lettuces to the *Ribes* and there give rise to the oviparous females; having copulated with the winged males, the former lay their few eggs on the *Ribes*. In wet weather the damage done by these plant lice to lettuces, etc., is intensified and the interior of the lettuce becomes not only disfigured by the insects, but also rots.

(3) *The Dark Sow-thistle Aphid* also does some damage to the seed crop. It lives on the Annual Sow-thistle (*Sonchus oleracæ*) and other plants.

This aphid is a rich chesnut-brown to deep shiny red; the cornicles are long and black and the tail yellow.

Control.—The only possible control of the two first species consists in destroying the aphides when on *Ribes* in winter or spring by spraying with carbolineum emulsions to destroy the ova or with nicotine soap washes to kill the hatched insects. All sow-thistles, *Crepis*, *Lapsana* and other weeds should be kept down, but when lettuces are once attacked it would not pay to adopt any curative treatment, even if such were possible, for the insects shelter in the hearts where they cannot be touched.

(4) *The Poplar Gall and Lettuce Root Aphid.*—One frequently finds on pulling lettuces, especially late ones, that the roots are covered with white flocculent wool. This is due to the above-mentioned aphid which comes from the poplar. In some seasons so many of these subterranean aphides occur that they kill the late autumn and early spring lettuces. The insect winters in two ways (*a*) on the roots of lettuce and other similar plants,

and (*b*) in the egg stage on poplars, where the stem mothers form very marked galls on the leaf stalks. One of these galls is formed by a single stem mother aphid, and in it she produces her young. The gall later bursts and the winged aphides fly away, usually in July. These winged forms place their young on the soil near lettuce and other roots. They are found in colonies in the soil, often in cavities thickly massed together, with white wool near and around, as well as on, the roots of lettuce, sow-thistle, etc. They increase rapidly on the lettuce roots and may continue to do so all the winter. At the same time winged females may arise from them in late September, October and November, and these fly off to the poplars where they produce sexual forms and eggs are laid on the buds. On the bursting of the poplar galls, the cycle is repeated. It becomes first noticeable on lettuce roots in August and gradually increases until February, when it dies down and none are noticed from May to July.

Treatment.—Obviously we cannot stop infection of the soil, as it is impossible to deal with the insect on poplar trees, but where summer lettuces have been attacked, it is just as well to destroy the insect in the soil, especially if lettuces for late winter and early spring use are to be planted there. The common practice of leaving lettuces killed by frost or rotting from wet in the soil should be avoided. As the aphid will not only live on lettuces but on sow-thistles, etc., if these occur, and any white wool is found on the roots they should be burnt and the ground dressed with naphthalene and dug in, or it should be very deeply cultivated.

The Artichoke Root Lice (*Trama troglodytes*, Heyden).—Jerusalem Artichokes are very often attacked by these pale-coloured subterranean aphides. Although they do not in the least affect the growth of the stem and leaves of such strong plants, they, nevertheless, by means of constant puncturing of the tubers, cause many of these to decay before they are lifted and many more afterwards. These aphides frequently occur in masses in artichoke beds and are always attended by ants, which take from them the sweet honey-dew they exude.

These pale fat plant lice can at once be distinguished by their long hind legs, the so-called second tarsal segment being very long, and by the curious way they lift up their hind legs if touched or frightened. The wingless females vary in colour from pale yellowish-white to pearly-white or dull yellowish-green, often semi-transparent. The antennæ are brown and less than half the length of the body. The winged female has a broad head and thorax and a small body; the antennæ are short, not much longer than the head and thorax, and the cornicles are slightly raised.

These aphides occur in the soil at all times of the year. The wingless forms feed on the roots of many other plants, including sow-thistles and thistles, etc., and are frequently found with ants in their nests.

Treatment.—After artichokes have been lifted the beds should be dressed with some soil insecticide, as the insects go on multiplying in the ground.

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FRUIT PACKING AND MARKETING IN CALIFORNIA.

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THE State of California, being on the western seaboard of the United States, has a climate tempered by the warm seas of the Pacific Ocean; the summers are hot and the winters almost free from frost, so that a large range of varieties of fruit and nuts can be cultivated out of doors as, for example, apples, apricots, cherries, figs, grapes, nectarines, peaches, pears, persimmons, plums, prunes, quinces, oranges, lemons, strawberries, blackberries, loganberries, raspberries, gooseberries, currants, olives, almonds, pecans and walnuts. It could not, of course, be claimed that all grow to perfection. Apples, oranges and pears are seen growing in the same locality, and sometimes in the same field, yet this arrangement must be due partly to the ambitions of the cultivator, for no one set of conditions can accommodate well all these kinds of fruits. Placed in sheltered positions between the Coast Range and the Cascade Range of mountains are numerous wide flat valleys, such as the Sacramento Valley and the Imperial Valley, where the soil is extremely fertile if only sufficient soil moisture can be provided to keep the plants growing. In most localities the heat of the summer sun is too intense and the normal rainfall is insufficient to maintain good plant growth. Irrigation is therefore almost universally practised, the water being taken from wells, rivers or even from the snow water from the glacier and high mountains of the Cascade. Under these conditions, California has been able to develop a fruit-growing industry of exceptionally large dimensions, though owing to the extreme length of the State the several fruit regions are far apart, that of the Imperial Valley in the south being fully 750 miles from the Shasta area in the

north—as far as Kent is from Inverness. Yet, as will appear later, the grading, packing and marketing of the deciduous fruits from all these widely separated areas is all done under the influence of one large growers' organisation. Each separate valley where fruit can be grown has its own peculiarities which have been exploited for the production of some special crop. There are thus a number of isolated areas important for the production of one, or at most two, crops.

With a helpful climate and fertile soils situated in sheltered valleys, the production of fruit even in large quantities was not a difficult matter: by no means was it as serious as the problem of marketing, and the difficulties of the earlier growers centred almost entirely around marketing. The difficulties were very great, on account of the vast distances to be covered before the fruits reached the markets. Thus, almost at the commencement, growers were drawn together to seek for an organisation whereby they might collectively overcome the obstacles of proper packing, transportation and marketing, which appeared to be too big for individual effort. Men came together, not from over the wide field of the whole State, but just a few here and there engaged in a similar industry and generally situated in the same locality; these banded together to work for the common good and formed small Growers' Associations to put the results of their deliberations into practice.

One of the earliest of these associations to be formed was the Sacramento River Association. It is located in one of the finest parts of the State for fruit growing, with a climate particularly favourable to the growing of deciduous fruits, and especially the William Bon Chrêtien, or Bartlett, pear.

This association at present includes about sixty growers and shippers, some of whom have been identified with the organisation since it was formed twenty years ago.

The association now operates three sheds for receiving fruit for assembling for eastern markets—the Sacramento Docks, Walnut Grove and Hood. Generally the members are engaged in farming large acreages of fruit and are able to establish their own packing sheds and to carry out the grading and packing of the fruit on the farms. At Hood, however, the association in 1923 found it necessary to erect a community packing house where the fruit could be graded, packed and sent out under uniform labels. This packing house, which is two storeys in height, is a fine type of construction, equipped with modern labour-saving facilities for the efficient handling of box

fruits, which consist mainly of William (syn. Bartlett) pears. The pears come to the house early in July, and are practically all harvested by 15th August. In the packing house, the pears are run through a mechanical sizer, whereby the bulk is sorted, either by weight or width, into different sizes. Girls pack direct from the bin, wrapping each pear in paper before placing it in the standard pear box, carrying out that operation in much the same manner as has been described for apples,* though perhaps a greater number of styles of pear packs are admitted to be commercial than are recognised for the apple. After leaving the packer, the pear boxes are fastened, labelled and checked before being assembled for delivery to the market.

Plums.—Plums, chiefly of the varieties Tragedy, Santa Rosa, and Formosa, rank next in importance. They also are well packed, though for grading and sizing no mechanical devices yet tried have proved successful. The tree-gathered plums are brought into the packing house and emptied on to packing tables, which are wooden frameworks usually fitted with burlap or canvas bottoms or with wooden bottoms padded with various materials. Any type of table that would prevent bruising appeared to give satisfaction. Here, girls sort and grade the plums and pack them, two layers deep, into square chip baskets (without handles) each holding 5 lb. of fruit. Four of these chip baskets fit side by side into a cheap wooden crate which bears the labels, name of variety and net weight. The standard market package of plums from California is then a 20 lb. crate, but retailers have four separate baskets in each crate, and—I am told—are able to sell most of this kind of fruit by the unbroken basket.

Cherries.—The sweet cherry (Knight Early Black, Burbank, Black Eagle, Black Tartarian, Bing, etc.), is picked when nearly mature—that is, when practically all the changing of starch to sugar has ceased, and the fruit has attained the colour characteristic for the variety—into galvanized iron water pails in which they are delivered to the packing houses, where they are emptied into the packing trays, the boys being careful to pour the cherries out gently. Here they are graded for colour and size and packed into "Cherry Boxes" holding 10 lb. or "Cherry Lug" of 20 lb. The empty box, turned with the face down, is placed so as to incline towards the packer at an angle of about thirty degrees. The girls then select cherries

* "Packing Apples in the Okanagan Valley, British Columbia": This *Journal*, Feb., 1925, p. 1034.

FIG. 1.—The standard market package of plums, containing 4 square chip baskets each holding 5 lb. of plums all of the same size and colour.

FIG. 2—The cherry box holds 10 lb. of fruit. The two top layers only are packed in definite order.

of the same size and colour and place these on their sides in proper alignment and with the stems towards the paper. Holding the fruit in position with one hand and selecting fruits with the other, the packer arranges the cherries in line across the box. Each successive row is placed in direct alignment (straight pack) with the preceding one. Having packed the first layer in this manner, the second layer is packed by placing cherries in the spaces formed by the first layer. When the second layer has been completed the box is placed on the level and filled with cherries without regard to definite alignment. The bottom of the pack is neatly finished off so that the corners and sides of the box are well filled and no fruits or stems extend over the edges of the box. The whole is covered with paper and the box is ready to leave the packing bench to be fastened, labelled and dispatched. At times, the very best fruits are packed in cartons, four of which exactly fit into the tin-framed box.

The Sacramento River Association operates over a comparatively small area. In other districts, similar associations operating in much the same way have been formed, so that in the whole State there must be nearly one hundred of these local associations, all working under standard by-laws, with such variations as may be necessary to suit local conditions; and all are said to be incorporated under the co-operative laws of the State of California, as non-stock non-profit associations.

Each local association elects its own Board of usually five Directors, with a President, Vice-President and Secretary, and appoints its own manager and packing-house employees.

The earliest formed societies had, no doubt, to make their own arrangements with the Railway Companies for the dispatch of the fruits to the markets and for their sale in the markets, but, by 1900, the deciduous fruit-growers in California had come to the conclusion that if the fruit industry was to survive, the system of marketing must be greatly improved and, in fact, the marketing of the whole produce centralised as far as possible in one exchange. The many local associations agreed to limit their functions to assembling, grading, packing and loading the fruit, and they agreed to co-operate in setting up a selling organisation—the California Fruit Exchange—to sell the produce for all societies. In 1907, this Exchange was reorganised on a capital stock basis, with a permissible capitalisation of $100,000 divided into one thousand shares of $100 par value. Provision was made for the distribution of

these shares amongst bona fide fruit-growers, though no man could hold more than two shares.

The associations have a combined membership of over 6,500 growers, so that the quantity of deciduous fruits sold for the growers by this one organisation is very large, as instanced by the following figures which have been given to the writer by the manager of the California Fruit Exchange.

Year.	*No. of Cars.*	*Gross Sales.*	*Net Returns.*
1920	5,596	$13,473,801	$8,666,178
1921	6,281	$12,680,295	$6,952,475
1922	8,560	$12,935,832	$8,280,069
1923	10,935	$17,173,124	$10,629,060

To deal efficiently with such a volume of business, quite a large staff is required at the central organisation, as, for example, a General Manager's Department, Sales Department, Accounting Department, Traffic Department, Claims Department, Supply Department, Standardisation Department and Lumber Department. (This Exchange is distinct from the California Fruit Growers' Exchange, which is a similar but larger organisation trading in citrus fruits.) Practically no fruit is sold f.o.b. in the producing centre, and in that respect their policy differs from that of all other exchanges previously described,* though the same method is adopted by the California Fruit Growers Exchange in selilng citrus fruits.

By contract with the California Fruit Growers' Exchange, the members of the California Fruit Exchange now utilise the marketing machinery which has been set up by the former for selling citrus fruits. The Exchange is represented by salaried agents in some eighty cities and towns, and in this way secures a wide distribution and fewer glutted markets. The price at which the fruit is to be sold in the towns is fixed by the sales department of the central organisation, and the salaried representatives in the towns attempt to sell in car-loads lots to wholesale merchants and others, or, failing that, they send the fruit for sale in the auction rooms, where they are able to attend the auctions and watch the prices. By having their own representatives in the markets the Central Exchange claim to be able to regulate their cars to the several markets in a more orderly manner ; to hold car-loads back in order to catch better markets; or to reconsign loaded cars in transit to markets found to be glutted, to others less well supplied. It is a system which is

* Apple Packing in Nova Scotia, this *Journal*, Dec., 1924, p. 856; "Packing Apples in British Columbia," Feb., 1925, p. 1034.

said to have worked splendidly for the citrus fruits, and seems to be giving satisfaction to the deciduous fruit growers. It is important to bear in mind that these salaried agents operate in the markets as brokers and not as distributors, *i.e.*, they sell in lots of a car-load which may be anything between 700 and 800 boxes. Their business is done with the wholesale merchants, and, so far as the writer is aware, no selling to retailers has ever been attempted, nor did the Exchange seem to think that such a course would prove desirable or even economical.

All grower members of the Fruit Exchange are charged 7 per cent. for marketing the fruit, which is said to be the usual rate charged by commercial companies engaged in the same line of business. The Exchange does business at cost, and the difference between the actual cost of doing business in any one season and the 7 per cent. charged goes into a "Withholdings Account." This "Withholdings Account" constitutes the operating fund of the organisation. At no time in the history of the Exchange has its cost of doing business been more than 3 per cent., and the average cost over a period of the last six years has been 2.72 per cent. As a usual thing, therefore, growers operating through the California Fruit Exchange have their business handled for about 3 per cent., and the remaining 4 per cent. is placed in the withholdings or operating fund, of which one-half is returned during the year immediately following the crop season and the other half at the expiration of five years. Thus, any grower who has been with the California Fruit Exchange for a period of five years receives back each year about 4 of the 7 per cent. deducted on the gross delivered selling price. This "Withholdings Repayable Account," now totalling $1,660,000, is seldom understood properly by the growers, but it seems a perfectly simple and sound plan for providing the working capital, and is preferable to borrowing from the Bank or to the issue of stock shares.

Year by year the Exchange seems to have increased its volume of business until at the present time it claims to be handling fully 45 per cent. of the total Californian production of deciduous fruits. Growers not making use of the Exchange have to make use of the selling organisations and packing stations of independent merchants, of which there are a large number at each fruit shipping point. The growers are, in fact, not tied to the Exchanges by contracts longer than twelve months, and in practice growers at times leave the Exchanges for a while and then sign on again. This freedom of action left to growers is advantageous and much appreciated.

The Central Organisation is also responsible for the purchase and distribution of practically all the material and equipment used in harvesting the crops throughout the State. It was, in fact, compelled at one stage during the War period, to enter the lumber business to secure material for making its fruit boxes, and now owns approximately 15,000 acres of timber, including saw mills, box factory, etc., a piece of business which has proved very profitable to the Associations.

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FURTHER OBSERVATIONS ON THE FOOD OF THE LITTLE OWL.

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MOST of the British resident species of raptorial birds, and particularly the owls, have been definitely classified as regards their potentiality for good or ill, but the case of the Little Owl (*Athene noctua vidalii*) is somewhat different; and as there still appears to be some doubt as to the economic status of this bird, and the question is one of considerable importance to agriculturists, a few observations from a field ornithologist may be of some value.

The subject has been dealt with by Dr. Collinge,* of the York Museum, far more exhaustively than has been possible by the writer, who is glad to find, however, that his conclusions closely resemble those arrived at by Dr. Collinge.

A brief résumé of the British history of the species may be of interest. Since Waterton's initial essay in 1842 numbers of these birds have been liberated from time to time by various ornithologists, notably the late Lord Lilford and Mr. E. G. B. Meade-Waldo, more as ornithological experiments than as serious attempts to establish the species in this country. Before Waterton's time the little owl was not a resident breeding species, and the few examples recorded may be presumed to have been stragglers from the Continent or escapes from aviaries, private or otherwise.

From the point of view of the species itself, these experiments were a distinct success; so much so, in fact, that in many districts it is now our commonest owl. The species has multiplied abundantly and is rapidly extending its range. At

* See "The Food and Feeding Habits of the Little Owl," by W. E. Collinge, this *Journal*, Feb., 1922, p. 1022; March, 1922, p. 1133 (including bibliography); and Nov., 1922, p. 750.

the present time it is plentiful in the Midland, Eastern and Southern Counties, and last year the writer found it quite common as far afield as South Devon.

FIG. 1.—The Little Owl (*about ½ nat. size*).

Generally speaking, the food of the little owl is much the same as that of the majority of British owls, but as this bird has been accused of extending its depredations to the game covert and the poultry yard, it is proposed to discuss briefly the evidence afforded by a series of observations.

As the little owl frequently hunts by day as well as at night, it must be admitted that its opportunities for harm are considerably greater than those of most owls, and, as already mentioned, it is significant that most of the complaints on this head emanate from gamekeepers and poultry farmers.

Apart from the examination of the stomachs of specimens, probably the most reliable methods of ascertaining the food of owls are :—

(1) Inspection of the remains found in the birds' nesting holes, and

(2) Systematic examination of the pellets cast up by the birds.

As regards method (1), out of some thirty nesting holes kept under observation at different periods, the writer has on two occasions found evidence of objectionable operations. The first item was the wing of a full grown partridge (a somewhat surprising find, and in view of the difficulties of size, weight and transport, possibly one better left out of consideration). the other being a week-old Wyandotte chick. This is a decidedly meagre result from the point of view of the prosecution. and one that would appear to show that the victims were the result of occasional lapses, rather than staple items of the owls' diet.

It must be admitted that this method has its defects, and that much more satisfactory results may be derived from dissection of the pellets. The results obtained by this latter means are extremely interesting. The tests covered a period of three years. were carried out in two counties, and concerned twelve nesting holes, all of which were visited at regular intervals during the breeding season, in districts where game and poultry are plentiful.

Below are given particulars of the contents of the pellets examined, together with the number of pellets examined at each nesting hole :—

No.	*County.*	*No. of Visits.*	*Total Pellets examined.*	*Contents of Pellets.*
1.	Kent ...	4 ...	12	Bones and fur of small rodents, feathers and bones of house sparrow.
2.	,, ...	3 ...	15	Bones and fur of rodents, bones of small bird (species not ascertained).
3.	,, ...	4 ...	16	Bones and fur of rodents, fragments of shell of snail (apparently *H. aspersa*), elytra of carabid beetles.
4.	,, ...	3 ...	9	Bones and fur of rodents, bones of small birds (finches).
5	,, ...	4 ...	16	Bones and fur of rodents, numerous elytra of carabid beetles, wing bone of blackbird.
6.	,, ...	3 ...	15	Bones and fur of rodents, bones of small fish (minnow).

No.	County.	No. of Visits.	Total Pellets examined.	Contents of Pellets.
7.	Essex ...	3 ...	15	Bones and fur of rodents, numerous elytra of common cockchafer (*Melolontha vulgaris*), leg bones of sparrows.
8.	,, ...	4 ...	12	Bones and fur of rodents, elytra of cockchafers, fragments of snail shells.
9.	,, ..	3 ...	15	Bones and fur of rodents, portions of grit, elytra of beetles.
10.	,, ...	4 ...	20	Bones and fur of rodents, skull of house sparrow, fragments of noctuid pupa cases, elytra of beetles.
11.	,, ...	4 ...	12	Bones and fur of rodents, bones of common frog, elytra of various beetles.
12.	,, ...	4 ...	16	Bones and fur of rodents, elytra of various beetles.

It will thus be seen that, in every nesting hole, the pellets examined contained the fur and bones of rodents, and the following is a summary of the remaining contents:—

In 8 nesting holes pellets contained wing cases of beetles.
,, 6 ,, ,, ,, ,, bones and feathers of small birds.
,, 2 ,, ,, ,, ,, fragments of snail shells.
,, 1 ,, ,, ,, ,, bones of small fish.
,, 1 ,, ,, ,, ,, bones of frog.

There would, of course, be no trace in the pellets of such soft food as earthworms and larvæ of insects.

As already mentioned, Dr. Collinge's series of tests was much more extensive and the results correspondingly more valuable, but the results tabulated above are of assistance in the task of determining the agricultural status of the little owl. Altogether, the results of investigations carried out by various ornithologists up to date may be said to show that the evidence in the bird's favour is strong.

It would be idle to deny that most of our raptores suffer occasional lapses in the matter of slaughtered domestic birds and young game, but the writer's opinion is that, so far as the owls are concerned, such instances are exceptional. It is to be hoped that the time is not far distant when the true value of our owls will be recognised generally, and it is gratifying to note that already much has been accomplished in this direction.

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MAY ON THE FARM.

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Arable Land.—Towards the end of May, or earlier in a dry warm season, the Turnip Fly may begin to infest turnip seedlings. Their sudden and mysterious appearance in large numbers was formerly attributed to the seed having contained the eggs; but it is now known that the beetles are about and breeding a month or two earlier in the year, feeding on cruciferous weeds such as charlock. They fly freely when the temperature of the air is in the neighbourhood of 70° F., and apparently they are attracted to the turnip crop by its scent. Possibly the protective virtue of soaking the seed in turpentine is attributable to its masking the natural odour of the crop. In favour of the practice may be mentioned the fact that soaking for about two days has no injurious effect on the growing properties of the seed but in fact slightly accelerates germination.

It is generally agreed that measures which enable the crop to reach the rough-leaf stage quickly are the best means of preventing destruction by this pest: a good tilth (*i.e.*, fine, firm, moist soil) containing a little superphosphate and nitrate of lime favours quick establishment of the plant. Rolling when the seedlings are through the ground will often assist, especially where the soil was rather dry and loose at sowing. I have also seen the beetles driven off by an application of sawdust containing paraffin. Dusting with noxious powders such as soot, basic slag, lime and sulphur has also been advocated and tried: in 1911 experiments were conducted by the East Anglian Institute and it was found that soot, sulphur and spent tan were of no remedial value; lime had a slightly beneficial effect; paraffin emulsion drove the beetles off for one day; but the application of 1 cwt. nitrate of lime per acre was attended with considerable success.

Mangold seeds and seedlings also have their insect enemies: but as these are not readily found by the farmer he rarely attributes a failure of the mangold plant to this cause. Drilling too deeply, lack of lime in the soil and the application of an excess of soluble fertilisers may account for failure, but insect attack is not uncommon. Each case of mangolds coming up unsatisfactorily or going away should be reported to the County Agricultural Organiser for investigation, with the assistance of the Provincial Advisory Officers where necessary.

The weather in May is as a rule favourable to the work of killing weeds, either by dragging them out of the ground and drying them on the surface in the case of free soils, or by drying the clods containing the weeds where the soil is of heavier texture. In the latter case, however, it may not be possible to sow until June. Under these conditions crops of deeper rooting habit and better drought resisting properties than swedes may be preferable, viz., common turnips and marrow stem kale. Both of these, as they cover the ground more quickly than swedes, may also be of advantage where quite satisfactory cleaning before sowing is impossible.

Regarding varieties of swedes, attention may again be directed to the existence of sorts which, on land infected with finger-and-toe disease, are less susceptible to injury by this pest than the ordinary varieties. Tipperary, a quick growing and heavy cropping purple-top swede, grows well out of the ground and thereby suffers less lamage than sorts in which the "root" is more deeply inserted in the soil. Two Danish strains of Bangholm, viz., No. 25 and No. 4, have been proved to possess considerable powers of resistance to the disease.*

May Pasture and Milk Yields.—Ordinarily the daily yield of a cow rises for a few weeks after calving then falls gradually with the advance of lactation until she goes dry, from the 38th to the 45th week, according to the date of service. In Fig. 1 are graphically represented the average daily yields at successive stages in the lactation of 95 cows which calved between 1st May and 30th June. The information embodied in the

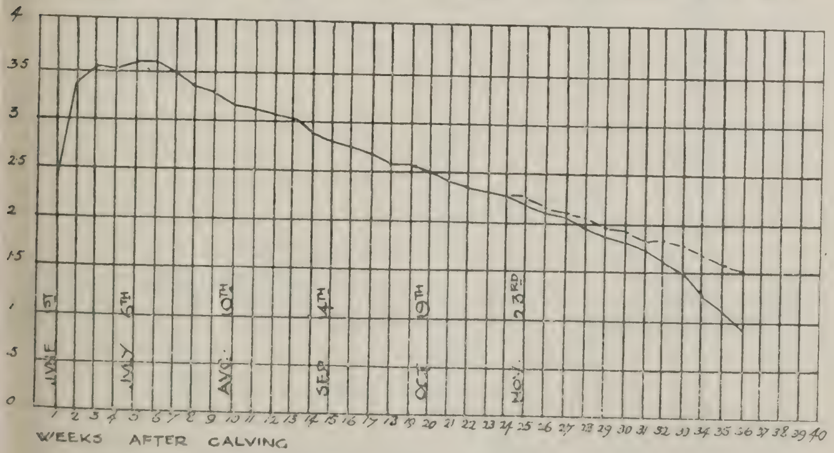

FIG. 1.—Variation in Milk Yield with advance of Lactation.

* See "Swedes Resistant to Finger-and-Toe," this *Journal*, July, 1922, p. 362.

curve was extracted by Gavin from the records of the Terling herd and published in the *Journal of Agricultural Science*, Vol. V, page 309.

In Fig. 1 the curve branches at the 24th week: the lower line represents the yields of cows served between the 9th and 12th week after calving, the depressing effect of pregnancy being apparent as an accelerated fall in yield from about the 14th week after conception. The upper curve shows the effect of deferring service for a further eight weeks. Besides the incidence of pregnancy, however, there are other influences which modify the yield curve for individual cows—the efficiency of the milkers, the condition of the animal at calving and the nature and quantity of the ration. An autumn or winter calver on going out to pasture in May "flushes" or increases her yield by 5 per cent. to 20 per cent. according to the winter feeding and management and the quality of the pasture to which she is transferred. The effect of May pasture on the daily yield of the winter calver is indeed an important consideration: a rise of 20 per cent. suggests that the winter ration has been defective or that the cows have had insufficient water; a fall or even the absence of a rise of 1 to 2 lb. in daily yield during the month of May would appear to indicate that the pasture land required improvement or that the winter diet had been excessively rich.

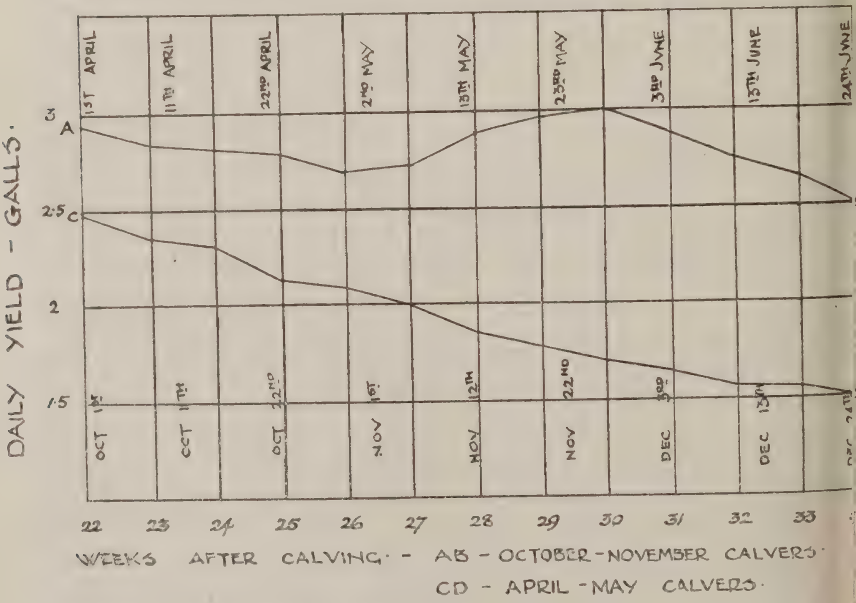

FIG. 2.—Effect of May Pasture on Milk Yield.

In Fig. 2 are represented the average daily yields in 89 lactations of cows in Mr. C. Fielding's (Matlock) herd of Lincoln Reds during the 6 years 1919-24. The upper curve, A.B., embodies the April to June part of 47 lactations, typically October-November calvers: their average yield per annum was 8,687 lb. The lower curve, C.D., embodies the autumn part of 42 lactations, typically April-May calvers with an average annual yield of 7,574 lb.

The increase in yield shown as due to pasture in the upper curve of Fig. 2, is greater than that normally associated with a change from efficient winter feeding and management to fair May grass. The curve represents, however, the yields during six years, in three of which the previous winter feeding was unavoidably unsatisfactory. During the three years 1918-20, concentrated foods were scarce and very expensive, linseed cake, for instance, being £20 or more per ton. During the next three years the herd received a properly balanced winter ration, fed slightly above the cows' requirements as measured by the accepted feeding standards. The following figures show the difference between the yields in the two series of years:—

		Years	
	1919-21	*1922-24*	*1919-24*
No. of lactations	22	25	47
Average No. of weeks calved...	21.7	21.5	21.6
Average yield per annum ...	7,888 lb.	9,391 lb.	8,687 lb.
Average yield per day:			
Indoors: April 1	26.5 lb.	31.8 lb.	29.3 lb.
„ 8	25.3 „	31.1 „	28.3 „
„ 15	25.1 „	30.7 „	28.1 „
„ 22	25.9 „	29.9 „	28.0 „
„ 29	24.9 „	28.7 „	26.9 „
May 6	26.2 „	28.3 „	27.3 „
On Pasture: May 13	29.6 „	28.5 „	29.0 „
„ 20	30.0 „	29.5 „	29.8 „
„ 27	29.9 „	30.4 „	30.1 „
June 3	28.5 „	29.2 „	28.9 „
„ 10	27.1 „	27.5 „	27.4 „
„ 17	26.1 „	26.8 „	24.4 „
„ 24	24.8 „	25.0 „	24.9 „

In the above averages and curves (Fig. 2), no lactation has been included in which the cow had calved within 6 weeks previous to 1st April or 1st October: the object of this was to exclude increases due to the natural tendency to rise in yield during the first few weeks of lactation.

The effect of May pasture on the quality of milk has not been studied so thoroughly as its effect on quantity. Generally some depression in quality might be expected to accompany a considerable rise in yield on going out to grass; and, under certain

conditions, the morning's milk might be found to contain less than the accepted standard of 3 per cent. of fat: this might be the case where the night interval between the milkings exceeded 13 hours and where the majority of the cows in the herd were spring calvers.

The Dairy Farm.—The following particulars are typical of a fairly well-stocked Derbyshire dairy holding of 100 acres:—

	Acres	*Live Stock*	*No.*	*Labour*	*No.*
Pasture	50	Dairy Herd	24	Men ...	2
Meadow	30	Young cattle ...	16	Youth ...	1
Arable	20	Work horses	3		

On many farms a greater proportion of permanent grass is mown, and where the head of winter stock is not heavy, there is a tendency to feed excessive quantities of hay. Ration records in this county have indicated that hay fed in excess of about 17 lb. per cow per day is not well utilised. In other cases where the proportion of mown land is high, young stock are sent away to summer ley instead of being grazed at home: the money so spent on ley would in many instances produce a better return if expended on phosphatic dressings to increase the stock-carrying capacity of the home pastures.

A correspondent has raised the question of whether in the case of a small farm even 30 per cent. is not too great a part of the farm to be devoted to the comparatively low-productive hay crop. He suggests that the smallholder at any rate might with advantage keep more cows by grazing the whole of his permanent grass land and buying the hay required for the maintenance of the herd in winter. The question involved is whether tending and milking cows is more remunerative than cultivating and making the hay crop. I believe that it would often pay the small farmer to adopt the above suggestion, with the modification that wet grains should be bought to take the place of part of the hay that would otherwise be grown or purchased. Instead of growing hay sufficient to provide a daily allowance of 16 lb., the winter ration might contain 14 lb. of wet grains and only 8 lb. of hay, either home-grown or bought.

If the same policy were adopted generally and on larger holdings, hay growing would soon be more profitable than milk production and wet grains would rise to prohibitive prices. Under present condition, however, and where the requisite buildings and demand for milk exist, the above policy would appear to be attractive. This may be shown by estimates of

the financial results of the ordinary and the suggested systems of management. On the typical holding cropped and stocked as first mentioned the principal items in the annual account are roughly as follows:—

Expenses	£	*Returns*	£
Rent and rates	250	Milk: 24 × 650 gal. @ 1/2 ...	910
Labour	260	Calves: 12 @ £3	36
Help in haymaking ...	10	Fat cows: 5·6 @ £24... ...	132
Concentrates: 24 × 15 cwt. @ 11/-	198	Corn: 10 acres @ £9	90
Horse corn	45		
Other expenses and profit ...	405		
	£1,168		£1,168

In the above example the average daily allowances of home-grown foods per cow equivalent during a winter of 190 days are:—roots (18 tons per acre), 33 lb.; hay (25 cwt.), 16 lb.; and straw (30 cwt.), 5 lb.

If the farm were cropped as 75 acres pasture and 25 acres arable, it would carry 30 cows and heifers and 20 young stock. The additional returns and expenses would probably be the following:—

Additional Expense	£	s.	*Additional Returns*	£	s.
Labour: third man in place of youth, less special hay labour	42	0	Milk: 6 × 650 gal. @ 1/2 ...	227	10
Concentrates: 6 @ £8 5s.	49	10	Calves: 5 @ £3	15	0
Hay: 40 × 8 lb. × 190 days = $27\frac{1}{4}$ tons @ £4	109	0	Fat cows: 2 @ £24 ...	48	0
Wet grains: 40 × 14 lb. × 190 days = $47\frac{1}{2}$ tons @ 25/- (6d. bus.)	59	8	Corn: $2\frac{1}{2}$ acres @ £9 ...	22	10
Balance = advantage ...	53	2			
	£313	0		£313	0

No account has been taken of the manurial residues brought on to the farm in the purchased hay and grains: if properly conserved and utilised these would amount to a further advantage of £40 per annum. But without meadow land and with only 25 acres arable, it is doubtful whether proper use could be made of all the manure produced, viz., about 250 to 300 tons per annum. Better use of the manure is made where the farmer cultivates a greater acreage of crops that require liberal manuring—mangolds, marrow stem kale, potatoes or sugar beet. The system in fact lends itself to the inclusion of cash crops whereby manurial constituents are exported from the farm.

The main point of the above argument is that full use should be made of pasture: by slagging and by increasing the proportion of pasture at the expense of the hay land, increased numbers of cattle may be kept in summer: the limit may be set by labour considerations. As regards winter keep, I doubt whether any arable crop can be grown which will produce food at a less cost per unit than wet grains at 6d. per bushel delivered. The question of whether the dairy farmer could advantageously substitute part of his hay crop or replace part of his corn area with arable fodder crops—mixed cereals for hay or for silage, additional mangolds and marrow stem kale—is under investigation.

* * * * * *

MONTHLY NOTES ON FEEDING STUFFS.

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Water Consumption of Farm Animals.—A correspondent has raised an interesting and apparently simple question which is, however, more difficult to answer than would at first sight appear to be the case. The question was:—What is the daily quantity of water required by (1) a cow, (2) a year-old heifer, (3) a horse, during the grazing season? Simple though the question is, there appear to be few accurate data available upon which an answer can be based.

The water requirements of animals are met in several different ways. Firstly, a fair proportion of water is supplied in the food, particularly in the case of succulent feeding stuffs such as roots, grass and green forage crops. Thus, a bullock consuming 1 cwt. of roots receives over 9 gallons of water a day from this source. Concentrated feeding stuffs supply in the form of water about 1 gallon to 1½ gallons to every cwt., whereas grass and green succulent foods supply approximately 8 gallons of water for every cwt. of food consumed. The excess water required by the animal is generally obtained in the liquid form as drinking water. There is another source of water that is often overlooked, that is, water that results from the various chemical processes that go on in the animal's body. When starch, fat or protein is broken down in the animal's body, water is always an end product, and a certain amount of water becomes available for the animal's needs in this way. Thus

a pound of fat in breaking down in the animal's body yields more than its own weight of water, and a pound of starch or sugar similarly yields more than half its weight of water. This fact is illustrated by the interesting experiment of breeding weevils in desiccated flour, when it will be found that, although the larvae have never had access to water their bodies contain a large proportion of water, which can only have arisen from the chemical changes which have taken place in the food ingested.

The sources of gain of water to an animal are :—(1) Natural moisture in the food, (2) drinking water, and (3) water derived from metabolic processes. The sources of loss from the animal are :—(1) Water in dung and urine, and (2) water evaporated from the lungs and skin.

The amount of water consumed as drinking water will therefore largely depend upon the succulence of the food fed—the more succulent the food, the less drinking water will be required. The amount of water lost from the body will depend largely on the temperature of the animal's surroundings and the relative dryness of the atmosphere. This variable desire for water is well shown in the case of sheep. In the winter and spring sheep consume little or no water, whereas in a hot and dry summer special provision has to be made for drinking water for them. The demands of an animal for water will therefore vary considerably according to several factors—*i.e.*, dryness of atmosphere, temperature and state of succulence of the ration, and it is not possible to state accurately how much drinking water an animal will require. Kellner states an average based upon the dry matter of the food in the ration, *i.e.*, for horses, 2 to 3 lb. of water for every lb. of dry matter in the ration, and for cows 4-6 lb. of water for every lb. of dry matter in the ration. On this basis a horse eating 20 lb. of dry matter would require 6 gallons of water, and a cow eating 25 lb. dry matter would require 10 to 15 gallons of water a day. If roots or green succulent food were included in the ration, the demand for water would be considerably less.

In order to illustrate the distribution of water between the food, drinking water, urine and dung, the data obtained from an experiment carried out with oxen by Kellner nearly 30 years ago are of interest. Two full-grown oxen were used, one being fed with nearly 18 lb. of meadow hay, the other with nearly 20 lb. of a meadow hay and oat straw mixture. Both oxen drank daily 57 lb. of water, the food eaten contained approximately

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Ton. £ s	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.	Per cent of Digest. Crude Protein °/o
Wheat, British	—	—	12 5	0 16	11 9	71·6	3/2	1·70	10·2
Barley, British Feeding	—	—	9 10	0 12	8 18	71	2/6	1·34	6·5
,, Canadian :—									
No. 4 Western	36/3	400	10 3	0 12	9 11	71	2/8	1·43	6·5
,, ,, Feeding	33/6	,,	9 8	0 12	8 16	71	2/6	1·34	6·5
,, American	36/9	,,	10 5	0 12	9 13	71	2/9	1·47	6·5
,, Danubian	36/0	,,	10 2	0 12	9 10	71	2/8	1·43	6·5
,, Karachi	36/3	,,	10 3	0 12	9 11	71	2/8	1·43	6·5
Oats, English, White	—	—	10 0	0 13	9 7	59·5	3/2	1·70	8·0
,, ,, Black and Grey	—	—	9 13	0 13	9 0	59·5	3/0	1·61	8·0
,, Canadian :—									
No. 2 Western	30/9	320	10 15	0 13	10 2	59·5	3/5	1·83	8·0
Argentine	26/6	,,	9 5	0 13	8 12	59·5	2/11	1·56	8·0
Chilian	28/3	,,	9 18	0 13	9 5	59·5	3/1	1·65	8.0
Maize, Argentine	40/6	480	9 8	0 13	8 15	81	2/2	1·16	7·1
,, Australian	40/6	,,	9 8	0 13	8 15	81	2/2	1·16	7·1
Beans, English Winter	—	—	10 15	1 12	9 3	67	2/9	1·47	20·1
,, Chinese ,,	—	—	11 10	1 12	9 18	67	2/11	1·56	20·1
Peas, English Maple	—	—	11 7	1 8	9 19	69	2/11	1·56	19·4
,, Japanese	—	—	23 15†	1 8	22 7	69	6/6	3·48	19·4
Dari, Egyptian	—	—	10 10	0 15	9 15	75·2	2/7	1·38	7·7
,, Persian	—	—	11 5	0 15	10 10	75·2	2/10	1·52	7·7
Millers' Offals :—									
Bran, British	—	—	7 5	1 7	5 18	45	2/7	1·38	10·9
,, Broad	—	—	8 15	1 7	7 8	45	3/3	1·74	10·9
Middlings—									
Fine Imported	—	—	9 0	1 2	7 18	72	2/3	1·20	12·6
Coarse, British	—	—	8 2	1 2	7 0	64	2/2	1·16	11·5
Pollards, Imported	—	—	7 2	1 7	5 15	60	1/11	1·03	11·6
Meal, Barley	—	—	11 12	0 12	11 0	71	3 1	1·65	6·5
,, Maize	—	—	10 10	0 13	9 17	81	2/5	1·29	7·1
,, ,, South African	—	—	9 7†	0 13	8 14	81	2/2	1·16	7·1
,, ,, Germ	—	—	9 0	0 19	8 1	85·3	1/11	1·03	18·4
,, ,, Gluten Feed	—	—	10 5	1 7	8 18	75·6	2/4	1·25	20·0
,, Locust Bean	—	—	9 15	0 9	9 6	71·4	2/7	1·38	4·0
,, Bean	—	—	13 0	1 12	11 8	67	3/5	1·83	20·1
,, Fish	—	—	20 10	4 7	16 3	53	6/1	3·26	50·0
Linseed	—	—	22 7	1 11	20 16	119	3/6	1·87	19·4
,, Cake, English 12°/o Oil	—	—	13 15	1 18	11 17	74	3/2	1·70	25·3
,, ,, 10°/o Oil	—	—	12 17	1 18	10 19	74	3/0	1·61	25·3
,, ,, 9°/o Oil	—	—	12 12	1 18	10 14	74	2/11	1·56	25·3
Soya Bean Cake 6 % Oil			10 15	2 14	8 1	69	2/4	1·25	38·2
Cottonseed Cake, English 5½°/o Oil	—	—	7 15	1 15	6 0	42	3/0	1·61	17·6
,, ,, Egyptian 5½°/o Oil	—	—	7 10	1 15	5 15	42	2 9	1·47	17·6
Decorticated Cotton Seed Cake 7% Oil	—	—	12 17*	2 14	10 3	71	2/10	1·52	34·6
,, ,, Meal 7°/o Oil	—	—	11 2	2 14	8 8	74	2/3	1·20	36.3
Ground Nut Cake 7% Oil	—	—	10 5*	1 16	8 9	56·8	3/0	1·61	42·0
Palm Kernel Cake 6°/o Oil	—	—	8 0†	1 3	6 17	75	1/10	0·98	17·1
,, ,, Meal 2°/o Oil	—	—	8 0	1 4	6 16	71·3	1/11	1·03	17·1
Feeding Treacle	—	—	7 2	0 8	6 14	51	2/8	1·43	1·1
Brewers' Grains :—									
Dried Ale	—	—	8 0	1 4	6 16	49	2/9	1·47	14·0
,, Porter	—	—	7 10	1 4	6 6	49	2/7	1·38	14·0
Wet Ale	—	—	1 4	0 9	0 15	15	1/0	0·54	4.8
,, Porter	—	—	0 17	0 9	0 8	15	–/6	0 27	4·8
Malt Culms	—	—	8 5†	1 14	6 11	43	3/1	1·65	19·9

* At Bristol. † At Liverpool. ‡ At Hull.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the e March and are, as a rule, considerably lower than the prices at local country markets, the difference being due to ca and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 pe Its manurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 7 starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A s calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on hi market. The manurial value per ton figures are calculated on the basis of the following unit prices :—N. 13s. ; P_2O_5, 4 K_2O, 2s. 6d.

$3\frac{1}{2}$ lb. of water, and the water in the dung and urine amounted to 50 lb. The total water ingested amounted therefore to approximately 6 gallons, and the water excreted in the dung and urine amounted to 5 gallons. The oxen averaged approximately 12 cwt. live weight and the room temperature was approximately 61° F. These figures are from an accurately controlled experiment, and indicate that a bullock fed on hay and roughage would require 6 gallons of water a day, but if the ration included 70 lb. of roots, the water in the ration would be sufficient for the animal's normal requirements.

* * * * * *

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat - - - - -	1·16	2 2	71·6	7 15	0 16	8 11
Oats - - - - -	1·16	2 2	59·5	6 9	0 13	7 2
Barley - - - - -	1·16	2 2	71·0	7 14	0 12	8 6
Potatoes - - - -	1·16	2 2	18·0	1 19	0 4	2 3
Swedes - - - -	1·16	2 2	7·0	0 15	0 2	0 17
Mangolds - - - -	1·16	2 2	6·0	0 13	0 3	0 16
Beans - - - -	1·16	2 2	67·0	7 5	1 12	8 17
Good Meadow Hay - -	1·47	2 9	31·0	4 5	0 14	4 19
Good Oat Straw - - -	1·47	2 9	17·0	2 7	0 7	2 14
Good Clover Hay - -	1·47	2 9	32·0	4 8	1 0	5 8
Vetch and Oat Silage - -	1·34	2 6	14·0	1 15	0 7	2 2
Barley Straw - -	1·47	2 9	19·5	2 14	0 6	3 0
Wheat Straw - - -	1·47	2 9	11·0	1 10	0 4	1 14
Bean Straw - - - -	1·47	2 9	19·0	2 12	0 9	3 1

* * * * * *

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending April 15th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13.15	13.17	13. 0	13. 0	16. 9
„ „ Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	13.11*	13.11*	13.11*	13.11*	(N)13.1
„ „ „ neutral (N. 21.1 per cent.)	14.14*	14.14*	14.14*	14.14*	(N)13.11
French Kainit (Pot. 20 per cent.)	3. 2	3. 0	...	2.15	2. 9
„ „ (Pot. 14 per cent.)	2.17	2.15	2. 7	2.10	3. 7
Potash Salts (Pot. 30 per cent.)	...	...	3.17	3.15	2. 6
„ „ (Pot. 20 per cent.)	...	...	2.17	2.12	2. 7
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7.10	7. 5	7. 5	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	11.10	11.10	4. 9
Basic Slag (T.P. 30 per cent.)	3. 2§	...	2.12§	2.12§	1. 9
„ „ (T.P. 28 per cent.)	...	2. 1‡	...	2.10§	1.10
„ „ (T.P. 26 per cent.)	...	1.14‡	...	2. 8§	1.10
„ „ (T.P. 24 per cent.)	...	1.11‡	2. 0§	2. 6§	1.11
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 8	1.11
„ (S.P. 30 per cent.) ...	3. 7	3. 5	3. 8	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9.10	8. 5	8.10	8. 0	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6.15†	7. 0†	6.10	6. 0†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	...	...	13. 0	...	...
„ „ (N. 9, T.P. 10 per cent.) ...	...	...	...	12. 5	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station.

‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named, and at London are for not less than 4-ton lots. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

* * * * * *

MISCELLANEOUS NOTES.

Individual Tests for Agricultural Machinery.

IN May, 1924, a Committee was appointed by the Ministry of Agriculture to formulate a scheme for testing agricultural machinery, as recommended by the Machinery Advisory Committee. That Committee has now worked out its scheme and presented it to the Ministry.

Besides providing for the tests, the scheme requires that official certificates and reports shall be issued which will give farmers, distributors and manufacturers accurate and independent information regarding the utility, efficiency, reliability, working cost, and maintenance of each machine or implement tested. Machinery and implements of either home manufacture or overseas manufacture submitted through an accredited

agent in this country will be eligible for testing, but scale models will not be admitted. The cost of testing will be borne by the entrant in accordance with a schedule of fees which has been drawn up by the Committee, and set out in an appendix to the report. The Committee has drawn up general regulations to govern the admission of machines and implements for testing, a form of entry, and forms of certificate and report to be issued by the Ministry. It is recommended also that a small permanent Committee should be appointed to assist the Ministry in carrying out the testing scheme.

The Ministry proposes to appoint a permanent Committee, as recommended, and is preparing the necessary forms and instructions for enabling applications for individual tests of machinery to be dealt with. It is not proposed to publish the Report, of which this is a short summary, but copies of it may be obtained on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

* * * * * *

The Importance of the Poultry Industry.

IN the Report on the Agricultural Production of England and Wales, recently issued by the Ministry,* the results of the returns so far as the production of poultry and eggs is concerned are summarised as follows :—

"The returns collected in 1924 show that the number of fowls on agricultural holdings in England and Wales was substantially greater than at the previous census in 1921. The number of fowls of a year old or more was 15,123,000, and of these approximately $13\frac{3}{4}$ millions would be hens. At an average annual production of 100 eggs per hen, the total production of eggs on agricultural holdings in England and Wales would be about 1,375 millions, against 1,100 millions, the estimated production in 1922. It must be remembered that these figures do not represent the total production of eggs in the country, as they do not include the produce from fowls kept by occupiers of less than an acre or those kept in towns or suburban areas. It has been previously suggested that an addition of about one-third should be made for fowls not on agricultural holdings, and on this basis, the total production of eggs in England and Wales in 1924 would be about 1,800 millions.

"In the Report for 1922 it was stated that the number of poultry killed for food in any year might be estimated as

* Agricultural Statistics, 1924, Vol. 59, Part II.

approximately equal to the number of poultry hatched in that year and alive on 4th June. The number of poultry reared on agricultural holdings and killed for food in 1924 may, therefore, be estimated at: Fowls, 15,630,000; ducks, 1,420,000; geese, 400,000; and turkeys, 535,000. The estimated number of fowls and turkeys killed was much greater in 1924 than in 1921."

Mr. Edward Brown, of the National Poultry Council, in a letter to *The Times*, 30th March, 1925, puts the value of the eggs and poultry consumed in Great Britain in 1924 at nearly 40 million pounds sterling, of which a little more than 17 million sterling was home-produced. He also puts the poultry industry as about equal in value of outturn with that of wheat-growing.

The Minister of Agriculture had already recognised the growing importance of the poultry industry, and has asked the National Farmers' Union and the Poultry Trade to nominate members to serve upon his Poultry Advisory Committee. Its Chairman is the Ministry's Poultry Commissioner, Mr. Percy Francis, and its other members are Mr. Edward Brown and Mr. W. Brownson (Joint Secretaries of National Poultry Council), Mr. Hedworth Foulkes, B.Sc., Mr. W. Hammett (Lancs.), Mr. Tom Newman (Secretary, Scientific Poultry Breeders' Association), Mr. S. Street-Porter (Eastern Counties), Mr. T. R. Robinson (Secretary, National Utility Poultry Society), Col. S. Sandbach (Wales), and Mr. A. T. Walker (Lancs.).

To this body is now added the name of Mr. Harry German, Past President of the National Farmers' Union and Chairman of the Cereals, Livestock and Wool Committee of the Union; and Mr. A. S. Juniper, and Mr. Ambrose Keevil, O.B.E., both of the Central Markets, West Smithfield, London, E.C., who are appointed to represent the trade.

* * * * * *

The Agricultural Index Number.

PRICES of agricultural produce during March averaged 65 per cent. above those ruling in the corresponding month of 1911-13, as compared with 67 per cent. above in the previous month. Most commodities were cheaper than in February, and the decline of 2 points on the month was chiefly accounted for by the fall in grain prices and to the fact that the advances in fat cattle and sheep were not proportionally so large as in the base years.

In March, 1924, the percentage increase was 57 per cent. above pre-war level or 8 points lower than at present.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	—
May ...	180	119	71	54	56	—
June ...	175	112	68	51	58	—
July ...	186	112	72	53	52	—
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat declined in price, and on the average was 4d. per cwt. cheaper than in February, the index figure recording a drop of 4 points, but wheat remained comparatively dear at 79 per cent. above pre-war. Barley showed a much sharper fall, values declining by 1s. 4d. per cwt. on the month, while oats were reduced by 4d. per cwt. The index figure for barley declined from 59 to 45 per cent. above 1911-13, and is at exactly the same level as a year ago, while oats, which fell from 42 to 38 per cent. above the base years, are 1 point lower than in March, 1924.

Fat cattle and sheep were slightly dearer, but the increases were relatively less than in pre-war years, and the index numbers show a decline of 2 and 3 points respectively. Bacon pigs advanced in price from 11s. 1d. to 11s. 8d. and porkers from 11s. 10d. to 12s. 4d. per 14 lbs. stone, the index figure for baconers rising from 62 to 67 per cent. above that of the basic years, while porkers rose from 60 to 66 per cent. above.

Trade was quiet for dairy cattle and, on the average, prices were £1 5s. per head lower than in February, the index number falling 2 points on the month. Store sheep and pigs again advanced in value, and the former were more than twice as dear as in the base years, while store pigs were 47 per cent. dearer.

Butter prices declined 1d. per lb., the index number falling to 58 per cent. above 1911-13 as compared with 63 per cent. above a year ago. Eggs were 2d. per dozen cheaper than in March last year and declined by about 7d. per dozen as compared with February of this year, the percentage increase falling by 13 points to 49 per cent. above the pre-war price. Cheese

was 6s. per cwt. dearer than in the previous month, and the index figure rose 7 points. Milk, on the average, was slightly cheaper owing to a reduction in price of ½d. per gallon at Manchester, and the percentage increase fell to 82 per cent. above 1911-13.

Potatoes were rather cheaper than in the previous month, and as values usually advance in March the increase over pre-war years declined from 144 to 138 per cent. Several descriptions of vegetables became dearer, and the average for all kinds, not including potatoes, rose from 74 to 91 per cent. above the base years. Brussels sprouts were considerably dearer, prices advancing from 13s. 9d. to 18s. per cwt., the latter figure being 140 per cent. higher than in 1911-13, an increase of nearly 80 points on the month. Celery was unchanged in price, but with a fall in values in the base years the index figure shows an increase of over 20 points as compared with February. Onions sold at 12s. per cwt. as against 11s. in February, and at the former price were more than twice as dear as in 1911-13. Cauliflowers were 3d. per dozen dearer, but this increase was relatively less than in pre-war years, and the index number dropped about 20 points on the month. Cabbage again sold at 40 per cent. above 1911-13 prices.

Hay was about 2s. per ton cheaper than in February, and sold at slightly less than in the base years.

Index numbers of different commodities during recent months and in March, 1923 and 1924, are shown below :—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.		1925.		
Commodity.	Mar.	Mar.	Dec.	Jan.	Feb.	Mar.
Wheat ...	27	46	67	76	83	79
Barley ...	8	45	76	81	59	45
Oats	36	39	37	46	42	38
Fat cattle ...	54	52	44	52	53	51
Fat sheep ...	94	64	84	107	100	97
Baconers ..	69	26	49	57	62	67
Porkers ...	82	37	49	59	60	66
Dairy cows ...	58	64	55	53	50	48
Store cattle ...	31	41	37	43	46	43
Store sheep ...	92	85	85	102	100	104
Store pigs ...	136	45	38	49	48	47
Eggs... ...	55	68	51	82	62	49
Poultry ...	81	59	64	63	56	57
Milk	87	71	84	84	84	82
Butter ...	70	63	73	73	62	58
Cheese ...	95	71	51	49	50	57
Potatoes ...	—12*	173	166	152	144	138
Hay	42	1	2	1	0	—1*

* Decrease.

Stud Goat Scheme.

THE Scheme whereby smallholders and cottagers who keep milch goats have been obtaining the services of first-class stud goats for breeding purposes at a maximum fee of 5s., has proved so successful during the past season that it has been decided to continue it for another season. Although complete results are not yet to hand, it may be stated that during the season just ended, 75 stud goats were registered and 882 services given. It is hoped that these figures will be exceeded during the forthcoming season.

Stud goats complying with certain specified conditions are eligible for registration under the Scheme, particulars of which may be obtained from the British Goat Society which is administering the Scheme. Goat owners are reminded that applications for the registration of stud goats should be made direct to the Hon. Secretary, British Goat Society, 10, Lloyd's Avenue, E.C.3, not later than 1st June. It is *not* necessary that such applicants should be members of the Society.

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International Congress of Agriculture.

THE Twelfth International Congress of Agriculture will be held in Warsaw from 21st to 24th June, 1925. The Congress will be composed of official delegates of Governments and of agricultural institutions and organisations belonging to countries which are represented on the International Commission of Agriculture. The programme of the Congress has been divided into five sections—rural economy, crop production, livestock production, agricultural industries, agricultural research and education. Each section will deal with no more than 5 to 7 problems.

The fee for members of the Congress has been fixed at 10 zloty (30 French francs), which gives the right to take part in all the sittings and receive copies of the general report of the Congress free of charge. The languages to be employed for verbal communications will be Polish, French and English. Up to the middle of March over one hundred papers from sixteen different countries had been promised to the Congress.

The Congress will be followed by an excursion from 25th to 29th June, at a fixed price, to agricultural enterprises, experimental fields, agricultural schools, exhibitions, etc., as well as to interesting parts and beauty spots in Poland, including the famous virgin forest of Bialowieza and Cracow—" a gem of the middle ages."

Visits to Rothamsted Experimental Station.

THE Director of the Rothamsted Experimental Station, Sir John Russell, again extends a cordial invitation to farmers' and farm workers' associations and clubs, chambers of agriculture and horticulture, students' societies and other bodies interested in agriculture or market gardening to inspect the Rothamsted Experimental Plots during the coming summer. Mr. H. V. Garner, B.A. (Camb.), will be available to demonstrate the Plots at any time, and all who come can be certain that under his guidance their visit will prove both useful and interesting.

Among important items of interest are: experiments on the manuring of arable crops, especially wheat, barley, mangolds, potatoes; manuring of meadow hay; effect of modern slags and mineral phosphates on grazing land, hay land, and arable crops; crop diseases and pests; demonstrations of good types of tillages. At any convenient time from May to 30th October there is sufficient to occupy a full day, and there is provision for assuring that the time shall not be lost, even if the weather turns out too bad to allow of close investigation of the fields.

Sir John Russell will be happy to arrange full details with organisations of farmers, farm workers and others wishing to accept this invitation; small groups of farmers are specially welcomed. If possible, arrangements should be made beforehand; but it is recognised that farmers' movements must often depend on the weather, and no farmer need stay away because he has been unable to write fixing a date.

All communications and requests to visit the Station should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden. It would be a convenience if ample notice could be given so as to avoid the possibility of dates clashing.

* * * * * *

Foot-and-Mouth Disease.—Only two fresh outbreaks of the disease have been discovered since the publication of the April issue of the *Journal*. These were at Wadsley Bridge, near Sheffield, on 26th March. The usual restrictions were imposed on the movement of animals and the holding of markets, etc., in areas of about 15 miles radius round these outbreaks. All restrictions in connection with the former outbreak have now been withdrawn.

* * * * * *

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Chilean Nitrate Committee.—The Manuring of Hops. (20 pp.) London : Chilean Nitrate Committee, 1925, gratis. [63.3451-16.]

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South Eastern Agricultural College.—Fruit Bull 10 :—Fruit Pollination in Relation to Commercial Fruit Growing. (8 pp.) Wye, 1925, 1s. [63.41(08).]

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Day, G. E.—Productive Swine Husbandry. 4th edition. (384 pp.) Philadelphia and London : J. B. Lippincott, 1925, 12s. 6d. [63.64.]

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Veterinary Science.

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U.S. Department of Agriculture.—Dept. Bull. 1245 :—Stock-Poisoning Plants of the Range. (36 pp. + xliii pl.) Washington, 1924. [63.255.]

Poultry.

Punnett, R. C.—Sex-Linkage for Egg Production and Table Poultry. (32 pp.) London : "Daily Mail," 1925, 1s. [63.651 ; 575.1.]

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Spillman, W. J., and *Lang, E.*—The Law of Diminishing Returns :—
Part I. The Law of Diminishing Increment.
Part II. The Law of the Soil.
(178 pp.) New York : World Book Co. ; London : Harrap, 1924. [338.1.]

Valgren, V. N.—Farmers' Mutual Fire Insurance in the United States. (186 pp.) Chicago : University Press ; London : Cambridge University Press 1924, 9s. 6d. [368.1.]

U.S. National Council of Farmers' Co-operative Marketing Associations.—Proceedings of the Third National Co-operative Marketing Conference, Washington, January, 1925. (136 pp.) Washington, 1925, $1. [334.6.]

U.S. Department of Agriculture.—Dept. Bull. 1302 :—Development and Present Status of Farmers' Co-operative Business Organisations. (76 pp.) Washington, 1924. [334(73).]

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Agriculture, General and Miscellaneous.

The History of Agriculture in Wales, *C. Bryner Jones.* (Welsh Jour. Agr., vol. i, No. 1 (Jan., 1925), pp. 5-16.) [63(09) ; 63(42).]

Field Experiments with Various Types of Phosphatic Manures, 1924. (Jour. Dept. Lands and Agr. (Dublin), vol. xxiv, No. 4 (Feb., 1925), pp. 424-433.) [63.1672.]

Spraying for Weed Eradication, *W. E. Brenchley.* (Jour. Bath and W. and S. Counties Soc., vol. xix (1924-25), pp. 1-20.) [63.259.]

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Investigations on Yield in the Cereals. II. A Spacing Experiment with Wheat, *F. L. Engledow*. (Jour. Agr. Sci., vol. xv, part 2 (April, 1925), pp. 125-146.) [63.311.]

Potato Growing for Seed Purposes, *W. D. Davidson*. (Jour. Dept. Lands and Agr. (Dublin), vol. xxiv, No. 4 (Feb., 1925), pp. 374-423.) [63.512.]

Seed Mixtures for Temporary Grass: Investigations Conducted in Denmark and Sweden, and Observations on Trials of a similar nature in progress at Aberystwyth, *R. G. Stapledon* and *R. Jones*. (Welsh Jour. Agr., vol. i, No. 1 (Jan., 1925), pp. 60-98.) [63.33(*b*).]

The Improvement of Poor Pastures with Special Reference to the Manuring of Acid Pastures, *T. Wallace*. (Jour. Bath and W. and S. Counties Soc., vol. xix (1924-25), pp. 77-89.) [63.33-16.]

The Basket Willow Crop as a Means of Utilising Wet Land, *H. P. Hutchinson*. (Jour. Bath and W. and S. Counties Soc., vol. xix (1924-25), pp. 49-57.) [63.3412.]

Fruit Growing.

Recent Developments in Commercial Fruit Culture, *E. M. Bear*. (Jour. Bath and W. and S. Counties Soc., vol. xix (1924-25), pp. 34-49.) [63.41.]

Apple Packing Station: Progress in England, *H. V. Taylor*. (Jour. Pomol. and Hort. Sci., vol. iv, No. 2 (Jan., 1925), pp.113-116.) [63.41-198.]

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Field Observations on the Incidence of Leaf Scorch upon the Apple, *R. G. Hatton* and *N. H. Grubb*. (Jour. Pomol. and Hort. Sci., vol. iv, No. 2 (Jan., 1925), pp. 65-77.) [63.21.]

Concerning Fungus Pests, *S. L. Bastin*. (Jour. Bath and W. and S. Counties Soc., vol. xix (1924-25), pp. 57-72.) [63.24.]

Dry Treatment for Smut Diseases of Cereals, *K. Sampson* and *D. W. Davies*. (Welsh Jour. Agr., vol. i, No. 1 (Jan., 1925), pp. 169-176.) [63.24.]

Egg-Killing Washes, *A. H. Lees*. (Jour. Pomol. and Hort. Sci., vol. iv, No. 2 (Jan., 1925), pp. 113-116.) [63.295.]

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Animal Nutrition with Special Reference to the Rearing of Young Stock, *E. J. Sheehy*. (Jour. Dept. Lands and Agr. (Dublin), vol. xxiv, No. 4 (Feb., 1925), pp. 335-342.) [63.604.]

The Use of Cod Liver Oil for Farm Stock, *J. Golding*. (Essex County Farmers' Union Year Book, 1925, pp. 191-196.) [612.394; 63.60432.]

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Feeding the Cow According to her Yield, *J. Wilson*. (Jour. Dept. Lands and Agr. (Dublin), vol. xxiv, No. 4 (Feb., 1925), pp. 343-350.) [63.711 : 043.]

The Causes of Variations in Milk Records, *J. Hammond* and *H. G. Sanders*. (Jour. Bath and W. and S. Counties Soc., vol. xix (1924-25), pp. 20-34.) [612.664; 63.711(*b*).]

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What is Wrong with British Agriculture?, *A. G. Ruston*. (Essex County Farmers' Union Year Book, 1925, pp. 239-248.) [338.58; 338.1(42).]

Farm Costings, *J. M. Adams*. (Jour. Dept. Lands and Agr. (Dublin), vol. xxiv, No. 4 (Feb., 1925), pp. 351-373.) [338.58; 338.1(415).]

Farmers and the Grain Trade in the United States: An Interpretation of the Present Pooling Movement, *J. E. Boyle*. (Economic Jour., vol. xxxv, No. 137 (March, 1925), pp. 11-25.) [334(73); 63.311 : 38.]

The Canadian Wheat Pool, *C. R. Fay*. (Economic Jour., vol. xxxv, No. 137 (March, 1925), pp. 26-29.) [334(71); 63.311 : 38.]

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NOTES FOR THE MONTH.

Report of Committee on Stabilisation of Agricultural Prices.

The Ministry has issued as the second of its series of reports on economic questions relating to agriculture, a report by a committee appointed by the late Minister of Agriculture to consider the problem of the Stabilisation of Agricultural Prices.* The subject is one of the highest importance to British agriculturists, and the Report which deals with it opens up new fields for thought and inquiry into the complex economic conditions which surround British agriculture. It is to be hoped that persons who are interested in the modern organisation of agriculture will not fail to give these problems due attention.

The Report analyses the many causes which bring about fluctuations in the prices of agricultural commodities, and the harm which these fluctuations cause, showing in a striking manner that not only in recent years but in earlier periods of agricultural history, a sharp or prolonged rise in the purchasing power of money has had serious and sometimes disastrous consequences to agriculture. Generally, it favours a policy of monetary stabilisation on the lines of the financial resolutions of the Genoa Conference held in 1922, and recommends that steps should be taken to put this policy into practice.

The remainder of the Report deals with fluctuations in prices due to conditions of supply and demand. It shows how agriculture suffers in a peculiar degree from the fact that demand is relatively steady, while supply, depending as it does on conditions beyond the control of the grower, is liable to vary very widely. A striking example of this and its effects on prices is shown in the case of hops. Potatoes, eggs, fruit and vegetables, and indeed most other agricultural products, are liable to suffer similar fluctuations in a greater or less degree. The possible remedies are next considered, and attention called to the almost universal movement towards the centralisation of

* Obtainable from H.M. Stationery Office. Kingsway, W.C.2. price 1s. 6d. nét, 1s. 7½d. post free.

(61419) P.6./R.4. 8,000. 6/25 M. & S.

marketing in agriculture, and particularly to the great advances made in this direction in the United States and the Dominions.

Co-operative marketing on certain lines can, it is suggested, be applied in this country so as to diminish the harmful consequences of wide price fluctuations, and the Report puts forward the suggestion that what the Americans call " orderly marketing " might, if applied to commodities mainly produced in this country, be successful in creating a more even flow of agricultural produce to market. As regards marketing foodstuffs which are mainly imported from abroad, the possibilities of establishing a more stable system in regard to them are briefly reviewed and discussed.

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Annual Returns of Crops and Live Stock.

THE annual agricultural returns will be collected again this year on 4th June. The forms were issued at the end of May to all occupiers of agricultural holdings, and the returns should be made and forwarded without delay to the Crop Reporter, whose address appears on the back of the form.

These returns afford the only real measure of the dimensions of the agricultural industry, and of the changes in cultivation and the number of live stock from year to year. The tabulated results are the more valuable the earlier they can be published, and all occupiers of agricultural land are urged to complete their returns at the proper date.

This year additional questions are included in the forms, with a view of obtaining information that is necessary in connection with the Census of Production. These questions relate to the production of milk, dairy produce, poultry and eggs and to the births and deaths of live stock during the past year. It is hoped that occupiers of agricultural holdings will furnish this additional information as completely as possible.

The returns of individual occupiers will be treated as confidential, and will be used only for the compilation of statistics of economic value to agriculture.

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Land Drainage Exhibit at Wembley.

WITH reference to the Ministry's Research Exhibit in the Government Pavilion at the British Empire Exhibition (see this *Journal*, May, 1925, p. 103) it may be said that a question of outstanding importance in relation to increased production, and the health of man and his live stock, is that of land drainage. The Ministry has therefore introduced a special

model relating to land drainage. This exhibit has been prepared for the purpose of enlightening the man in the street as to the manifold and complicated problems of land drainage. The model, which is some 20 ft. long by 13 ft. wide, is divided longitudinally into halves in order to enable the greatest length of river to be compressed within the limited space available. It is not intended to be representative of any given river in this country, but to depict features which are common to several rivers.

One half of the model shows about 1½ miles of the outfall end of a tidal river, first emerging from a painted background, then flowing through low-lying marsh-lands and finally entering the sea. In this section of the model it has been found possible to include an indication of defence works, in the form of groynes and training walls, necessary not only to maintain the coastline, but also to prevent the river mouth from becoming silted up. As the countryside through which the section of river flows comprises fen-lands many feet under the level of high tides, it will be seen that protection against daily inundation can only be secured by earthen embankments along the river and the sea, and that the liability to flooding therefore increases according to the neglect to dredge the river or keep the embankments in proper repair.

Another feature introduced into this section of the model shows the desirability of dealing with acute bends on the course of a river by possible straightening, in order to produce a more rapid flow, which is the only means of securing the proper scouring essential to enable a river to evacuate itself with each tide. In this section of the model are also indicated the two methods of draining low lands into adjacent arterial channels: (1) by gravitation through sluices at low tides, and (2) by pumping over embankments. The range of three tidal sluices in the foreground is typical of several such structures existing in different localities protecting extensive areas from possible inundation.

In the other half of the model is shown an upland length of the same river, flowing through a valley of water-logged land, subject to frequent flooding, involving the loss of pasturage, crops and live stock by drowning and disease. This half of the model is designed to indicate generally the character of the country through which the tributaries of the main English rivers flow, conveying silt for long distances to the main channel.

Another feature introduced is a length of navigable canal, the existence of which almost invariably obstructs the natural drainage of the countryside, and not infrequently brings about the waterlogging of land by seepage through embankments and by the voiding of great quantities of excess water over weirs which overtax the original river. The main feature, however, is the neglected condition of the old river, with its fallen trees and sinuous bends, these being typical of the condition of many rivers in this country, particularly where water-power mills are in disuse, and the water wheels and gates being inoperative and dilapidated. Conditions are even more detrimental to agriculture where the navigation on a canalised river is derelict. Such conditions as those indicated have in many localities produced perpetual flooding on many rivers, a state of things to which the inhabitants have now resigned themselves, even to the extent of providing permanent elevated gangways as a means of crossing floods which ought not to occur at all.

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THE Ministry's Annual Report on the Prices and Supplies of Agricultural Produce and Requirements is now in the press and will be issued very shortly.

Prices and Supplies of Agricultural Produce and Requirements in 1924-25.

The Report reviews the price movements of the different commodities during 1924, and, by means of index numbers, compares prices over several years. The tendency towards stability in the prices of agricultural produce which was noticeable in 1923 has been followed in 1924 by a rise which, in the case of certain products, has been quite substantial, and during the 7 months September, 1924, to March, 1925, the general level of the prices of agricultural produce was 65 per cent. above pre-war. Prices of feeding stuffs advanced last summer, and during the 7 months above mentioned were at 64 per cent. above pre-war. Changes in the prices of fertilisers and seeds are also given. The effect of the new minimum rates of agricultural wages as fixed by the Agricultural Wages Committees is shown to have raised the average level of wages of ordinary agricultural workers by 3s. per week by March of this year.

The Report contains information as to the proportions of the estimated total supply of the chief agricultural commodities

which are home produced or imported from the Irish Free State, other British Possessions and foreign countries respectively, and brings out clearly the extent of the dependence of Great Britain on imports of different commodities.

The position as regards the provision of weighing machines for the weighing of live stock at markets is reviewed in the Report, and it is mentioned that a Bill has been drafted with a view to making it compulsory to weigh all fat cattle exposed for sale by auction at markets where a weighbridge is provided under the provisions of the Markets and Fairs (Weighing of Cattle) Acts, 1887 to 1891. The introduction of legislation for the compulsory weighing of fat cattle has been considered by the National Farmers' Union and the Council of Agriculture, and both bodies have expressed themselves in its favour.

The Report, which forms Part III of the Agricultural Statistics, 1924, is published by H.M. Stationery Office, and may be purchased through any bookseller, price 1s. 6d., or direct from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, price 1s. 7d. post free.

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White Clover.

THE Ministry has just published a new Miscellaneous Publication on "White Clover,"* which has been written by Mr. W. M. Ware, M.Sc., of the South-Eastern Agricultural College, Wye. It embodies the results of a study of the subject which has been carried out at Wye, Kent. The history, cultivation and properties of various strains of white clover are carefully discussed, and much useful and practical advice is given, particularly in regard to cultivation for seed and the harvesting of the crop. The important points to be considered in the purchase and sale of white clover seed are also fully dealt with. In the seed-growing districts white clover has certainly proved a useful source of income to many farmers, and has given better returns than other seed crops, such as cereals, mangolds, turnips, etc.—a circumstance which no doubt goes far to explain its present-day popularity.

The author makes a passing reference to the fact that much of the uncertainty experienced by purchasers as to the nature of the stocks of wild white clover they are offered might be removed if the growers could find it practicable to form County Associations similar to those already operative to safeguard the reputation of true strains of red clover in this country. This is

* Miscellaneous Publications, No. 46, obtainable from the Ministry's Office, 10, Whitehall Place, London, S.W. 1, price 6d. net (post free).

a suggestion which merits careful consideration. The formation of a Wild White Clover Growers' Association, with strict regulations as to certification of stocks, would doubtless prove a far better means for dealing with the question of genuineness than would penal regulations.

Attention may also be drawn to the fact that the presence of a high proportion of hard seeds in wild white clover is an indication that the seed was taken from really old pasture. The Seeds Regulations, 1922, made under the Seeds Act, 1920, require the percentage of hard seeds to be stated separately from the percentage of germination. The Seeds Regulations also require a statement to be made as to the percentage of Suckling Clover present in a lot of Wild White Clover when it is present to the extent of more than 2 per cent. by weight.

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Unemployment Insurance for Agricultural Workers: Departmental Committee Appointed.

THE Minister of Agriculture and Fisheries and the Secretary for Scotland have appointed Sir R. Henry Rew, K.C.B., Mr. John Beard, Mr. David Black, Sir Thomas Davies, M.P., Mr. Thomas Denholm, Mr. James Falconer, Mr. James Gardner, Mr. Thomas H. Ryland, Mrs. Lucy Deane Streatfeild, C.B.E., Mr. R. B. Walker and Mr. Denton Woodhead to be a Committee to consider and report whether it is desirable that workers in agriculture should be compulsorily insured against the risk of unemployment, and, if so, on what terms and conditions, and in what manner the insurance of agricultural workers can be most effectively provided, either by the inclusion of agriculture within the scope of existing legislation, or by means of new legislation.

Sir R. Henry Rew, K.C.B., has been appointed Chairman of the Committee and Mr. R. E. Stanley, of the Ministry of Agriculture and Fisheries, and Mr. F. W. Charlton, of the Ministry of Labour, Joint Secretaries.

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The Agricultural Index Number.

THE general level of the prices of agricultural produce was further reduced during April, the index number showing that prices were 58 per cent. above the corresponding month of 1911-13 against 65 per cent. in March. The index number was, however, 5 points higher than in April last year and 4 points above April, 1923, this being the eighth month in which prices of

agricultural produce have been higher than in either of the previous two years. The decline of 7 points recorded in April was due mainly to the lower prices of grain and milk and the sharp fall in the index number of potatoes owing to the comparatively greater increase in potato prices in the base years.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920 :—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	—
June ...	175	112	68	51	58	—
July ...	186	112	72	53	52	—
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat averaged 12s. 3d. per cwt. during April, a reduction of 1s. on the month, and the index number dropped by 17 points to 62 per cent. above 1911-13, and was back to the level of last September. Barley, of which the great bulk on the market would be of feeding quality, averaged 10s. 7d. per cwt., or only 38 per cent. above pre-war, and was 9d. per cwt. lower than in April, 1924. Oats also became rather cheaper last month, but realised practically the same as a year earlier.

Prices of fat stock have been very steady on the whole, and the index numbers show very little change from last month. The average price of fat cattle advanced by 2d. per 14 lb. stone, but this rise was relatively rather less than in pre-war years and the index number was reduced by 1 point. The opposite occurred with fat sheep, the reduction of ¼d. per lb. as compared with March, being relatively rather less than in 1911-13, and the index number advanced 3 points. Both bacon and pork pigs averaged 1d. per stone more than in March. As compared with last year, fat cattle realised much the same prices, but sheep and pigs were appreciably dearer, pork pigs having advanced by 2s. 1d. and bacon pigs by 2s. 8d., per 14 lb. stone.

Dairy cattle continued the fall in prices which has now lasted for six months and were about £3 per head cheaper than in April, 1924, and only 47 per cent. above 1911-13. Store cattle, although 5s. per head dearer than in March, showed a relatively smaller advance than usual at this season of the year, and the

index number was reduced to only 39 per cent. above pre-war, or practically the same level as a year earlier. Store sheep, as fat sheep, were at exactly double the pre-war price, and the sharp rise in store pigs brought these to relatively nearly as high a level as fat pigs.

The summer prices of milk are not so much above those of 1911-13 as the winter prices, and the index number fell from 82 per cent. above pre-war in March to 58 per cent. above during April. The reduction of ¾d. per lb. in the case of butter was relatively less than in 1911-13, and the index number rose by 6 points, while the increase of 3s. 6d. per cwt. for cheese caused the index figure to rise by 4 points. Butter was 1¾d. per lb. dearer than in April, 1924, but cheese was cheaper by 7s. per cwt. Egg prices were about ¼d. per dozen higher than a year ago, and although they declined by 1d. per dozen as compared with March the index figure was slightly higher.

Potatoes were 10s. per ton dearer in April than in the previous month, but in the base years there was an advance of 12s. 6d. in April and the index number was consequently appreciably smaller, although still high at 115 per cent. above 1911-13. Hay remained practically unchanged at pre-war prices. Cabbage averaged 45 per cent. above pre-war, and cauliflowers 87 per cent. above, but carrots remained relatively very cheap at only 11 per cent. above 1911-13.

Index numbers of different commodities during recent months and in April, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.	1925.			
Commodity.	April.	April.	Jan.	Feb.	Mar.	April.
Wheat ...	31	38	76	83	79	62
Barley ...	11	48	81	59	45	38
Oats	39	35	46	42	38	34
Fat cattle ...	51	49	52	53	51	50
Fat sheep ...	100	75	107	100	97	100
Baconers ..	63	30	57	62	67	68
Porkers ...	78	39	59	60	66	67
Dairy cows ...	55	63	53	50	48	47
Store cattle ...	29	38	43	46	43	39
Store sheep ...	92	84	102	100	104	100
Store pigs ...	131	42	49	48	47	64
Eggs... ...	37	48	82	62	49	51
Poultry ...	75	70	63	56	57	50
Milk	70	58	84	84	82	58
Butter ...	68	51	73	62	58	64
Cheese ...	92	71	49	50	57	61
Potatoes ...	—28*	154	152	144	138	115
Hay	40	0	1	0	—1*	—2*

* Decrease.

Agricultural and Veterinary Research Scholarships.

THE Ministry invites applications for research scholarships in agricultural and veterinary science. The number to be awarded will depend upon the qualifications of the candidates, and will not in any case exceed seven. The scholarships are tenable for three years from 1st October, 1925, and are of the value of £200 per annum. Applications must be received not later than 30th June, 1925. on the prescribed form (900/T.G.), which, together with a copy of the conditions attaching to the scholarships, may be obtained from the Secretary, Ministry of Agriculture and Fisheries, 10. Whitehall Place, London, S.W.1.

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Travelling Research Fellowships.

THE Ministry has awarded the following travelling research fellowships to enable members of its Research and Advisory Institutes to visit foreign and Colonial Agricultural Institutes and Stations in order to familiarise themselves with work collateral with their own which is being carried out in other countries.

Fellow.	*Value of Fellowship.* £
1. Dr. A. D. Imms of the Plant Pathology Research Institute, Rothamsted Experimental Station: Visit to U.S.A. and Canada to gain experience in entomological and general biological work ...	250
2. Mr. A. Appleyard of the Bristol University Fruit and Vegetable Preserving Research Station: Visit to U.S.A., Canada and France to study the canning of fruit and vegetables	250
3. Mr. A. M. Massee of the East Malling Fruit Research Station: Visit to Austria to study Plant Mites (*Eriophyidae*)	50
4. Mr. W. M. Williams of the Institute of Agricultural Engineering, Oxford: Visit to France and Italy to study Agricultural Engineering Research and Advisory Work, Testing of Agricultural Machinery, etc.	60
5 Mr. H. R. Davidson of the School of Agriculture, Cambridge: Visit to Denmark for the purpose of studying Animal Husbandry	20
Total	£630

THE PRINCIPLES OF AGRICULTURAL EXPERIMENTS.

SIR A. D. HALL, K.C.B., LL.D., F.R.S.,*
Chief Scientific Adviser to the Ministry of Agriculture and Fisheries.

THE particular point to which I am going to address myself can best be phrased in the famous introduction to one of Bacon's Essays: "What is Truth." How are we going to get at truth in our experiments? We find that we have to examine our experiments very carefully before they will yield us truth. In agriculture we have particularly tried to arrive at results by experiments, and one of the earliest forms which our experiments have taken has been to try and show upon the land how much better one variety of a farm crop, like wheat, may be than another, or how much better one treatment—be it by manure or by cultivation—may be than another, by putting down plots, side by side. We have the replica of the plot experiment when we come to examine questions of feeding. We have been accustomed to put a certain number of pigs or bullocks on one kind of diet and compare their rate of increase with that on another kind of diet. It will be familiar to many that the results obtained by this method of putting down plots and measuring the weights of their crops, are rather apt to be disappointing and sometimes confusing, for when we design the experiment we have a pretty clear idea of what the results ought to be, and yet the results have often not come out right. Various devices have been adopted by myself and my colleagues for camouflaging those kinds of results. Sometimes we have tried to explain them away, and given reasons for their occurrence. We have not always realised, I think, that those irregular results, as we might call them, were only to be expected. The present conference has been called to deal with this point. The central idea that I want you to perceive is that error is a normal circumstance of human life. We must accept this error but we can discount it, and we can reduce it to reasonable dimensions. The necessity of taking error into account arises from the fact that we are dealing, in agriculture, with living organisms, either plants or animals, and they are susceptible to an amount of variability that does not appertain to steel or iron or materials of that description. Even in the study of these

* Discourse delivered at the Conference of Agricultural Organisers at Oxford, April, 1925.

latter materials we have to expect errors, and make allowances for them, but in agricultural work, simply because we are dealing with living organisms, we have to expect much wider margins of error and take precautions to deal with them.

This error is inherent in all our work, and conclusions can only be reached from our experiments by submitting our results to a more or less statistical review. We want to get, as it were, the statistical frame of mind, and when I say that I mean something of this kind. We say, for instance, that men are taller than women. Well, that is true, statistically, but it has nothing to do with the fact that a particular man—any odd man you may meet in the street at any odd moment—may not be so tall as the next woman you meet. You have to take a certain number or "sample" of men and a "sample" of women, and these samples must be fairly large and taken without any bias, before you can verify the conclusion that men are taller than women. There is no certainty about particular instances, and, moreover, you may easily deceive yourself if the sample upon which you try to found your conclusion is not a true sample but badly selected. That is the kind of view which we have always to take into account, that before you arrive at your conclusion where material varies you have to make sure that you are reviewing a big enough sample and an honest one.

Casual Error.—Now let me come back to the important point of the question of the yields from plots. I can best illustrate my point by an examination of the records of some of our oldest experiments, the Rothamsted experiments. We may take a couple of plots on the barley field, plots that are fully manured, the only difference being that one has nitrate of soda and the other sulphate of ammonia. Now it happens that on the particular Rothamsted soil, on that particular field (well supplied with carbonate of lime) and for the barley crop these two sources of fertility are practically equivalent to one another. If we take the average results of those two plots in comparison with one another over the period of 70 years we shall find that the superiority of the nitrate of soda plot over the sulphate of ammonia plot is only in the order of 1 per cent. It is no more than just perceptible. Suppose, however, that we look at the individual years, we then begin to find that the yields from these plots are very irregular. There are times when one plot is better than the other, and sometimes the reverse. One method of comparison is to take the mean of the yields of the two plots and express the yields of one or other in individual

years as percentages of those means. Well, if I take the very first three years I find the yields differ as follows :—

Plot 1.	*Plot* 2.
95	105
92½	107½
99	101

There are these great differences at the outset between plots whose average yields are practically identical. Other years in which there were great differences between the two plots gave the following comparisons :—

Plot 1.	*Plot* 2.
89	111
112	88
97	113

This phenomenon may be traced through all the Rothamsted experiments in which the same treatment is repeated year after year, upon the same land, and where the very greatest care has been taken to avoid mechanical errors. In the case of the grass plots you may find in any year that a plot may vary by 20 per cent. from the position you would expect it to occupy relative to the others. You must take that as a general phenomenon attaching to the very nature of the work which we are trying to do. You might, of course, look very intimately into the circumstances of any particular year and you might perhaps find some reason for the abnormality—some effect of weather, subsoil, disease, etc., which was reflected on one plot and not on the other. These variables are so numerous and so irregular in their action that you can only give a probability that a certain result will be obtained in a particular year.

Suppose we look at another type of experiment. I would ask you to study rather carefully some figures which were set out in the "Journal of Agricultural Science" about 1911. About that time two papers were published, one by Professor Wood and Mr. Stratton* and one by Mr. Mercer and myself,† both of which attack the same problem but from a rather different angle. The plan we adopted was to take a normal, fairly uniform, crop sown on a uniform field in the ordinary way of business, and to divide that crop up into a series of plots. We weighed the yield of each of those plots with as great accuracy as we could. Two of the experiments dealt with the growth of mangolds, and one with wheat (at Rothamsted). The mangold field was divided into two-hundredths of an acre, and the roots and leaves were weighed separately. In the case of wheat an acre was divided into 500 separate plots. The grain from

* Vol. III, Pt. IV., December, 1910, p. 417.
† Vol. IV, Pt. II., October, 1911, p. 107.

each plot was thrashed out and the grain and the straw were weighed separately. The average weight of the mangold crop in the 1/200th acre plot was of the order of 360 to 370 lb., but we got a weight as high in one case as 384 lb. and as low in another case as 267 lb. The variation in yields may be illustrated by the following weights of adjoining plots "across" the field: 376, 371, 355, 356, 335, 332 lb., and the following weights of adjoining plots "down" the field: 376, 316, 326, 317, 321, 335, 341 lb. A close examination of the trend of the weights did show that the yields might be a little better on one side of the field than the other, but there was no great difference from top to bottom of the field. There was irregular variability which could not be assigned to any cause. A little group of plots gave yields of 324, 316, 342, 300, 286, 330, 317, 295, 308 lb. In close juxtaposition yields as high as 342 and as low as 286 lb. were obtained. The same results were obtained from still smaller plots on the wheat field. The variation in these cases was as follows. The average weight of grain per plot was about 4 lb., but individual yields as high as 5.16 lb. and as low as 2.73 lb. were obtained. These were variations of 30 per cent. on either side of the average.

The objection may be raised that variations of the kind were to be expected in dealing with that acre of land, or that errors were introduced as a result of the small size of the plots. There was nothing to indicate in the look of the fields that they were irregular. The areas in both cases were picked out as seeming by eye to be very uniform. I would like to digress here to ask if you have ever tried to consider what kind of differences in crops you can estimate by eye. We had a very good chance of testing this point at Rothamsted. We made a practice of asking farmers well accustomed to judge to estimate the differences in yields between plots on the Little Hoos field and of comparing these estimates later with the actual yields. As a result we came to the conclusion that it was practically impossible to detect by eye differences of less than 20 per cent. in yields. Only differences of this order came to the eye, so that when a difference of 5 per cent. was estimated by the eye it was actually 25 per cent. It is very difficult to detect differences in root crops, because a small difference in diameter makes a large difference in weight of root. Psychologists have told me that it is a general law that if by your judgment alone you are going to sort out things into a series of classes you cannot make more than five such classes, *e.g.*, very good, good, middling, bad, very bad.

Now let us come back to the mangold and wheat plots. We wanted to see if there was any fundamental source of error affecting the results, that is whether the variations were of a "normal" or an "abnormal" character. Now we might take another set of numbers instead of these results. Suppose you want to find the kind of variation in the weight of something that grows naturally? We used to speak of the weight of a barley corn as a unit of weight, but if you examine a thousand barley grains you find the same kind of variation of which I am speaking, you get a lot of grain falling about the mean in weight, but a few varying widely from the "legal" barley grain in weight. How should we proceed to examine this variation? This first thing is to throw your material into a curve, and see how far that curve agrees with the "normal curve of error." You must classify your figures into groups. We can class the mangold weights into groups by every 10 lb. Our lowest weight was about 280 lb. We find the numbers of results falling into the groups 280-289 lb., 290-299 lb., etc., and plot a curve of the results in the following way.

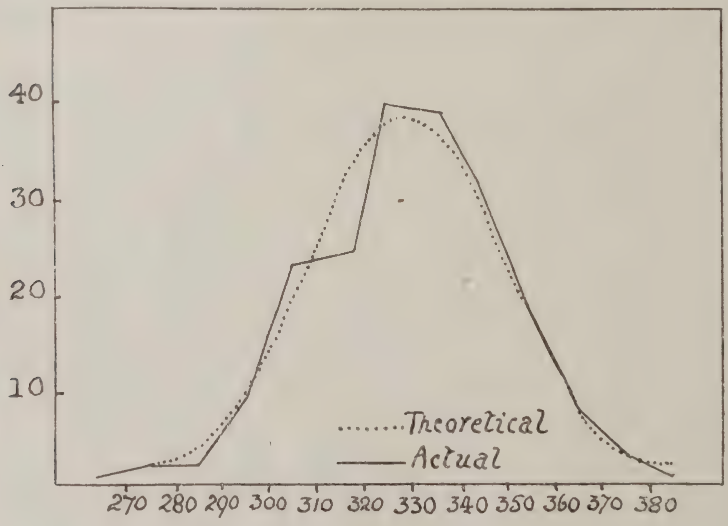

FIG. 1.—Frequency curve for 200 Plots of Mangold roots; actual and theoretical.

This curve approximates closely to the normal curve of error or frequency curve which is shown in the above figure by a dotted line.

A curve approximating to this shape at once gives us the information that we are dealing with uniform material, that our

sample is a proper one and that our variations are casual. You may sometimes find your curve not one of this description. You may find that the curve is not symmetrical on both sides of the apex, in which case your material is not homogenous or you may get two peaks, which shows mixed material, the curve being the resultant of two curves, each with peaks of its own. In the case of the mangold and wheat plots we were therefore able to satisfy ourselves that we were dealing with quite uniform material. You can find just the same kind of thing if you take a very large number of beans and sort them out by weights. With such material, if you tabulate deviations from the mean they will always fall into a curve of this description. This is a test that your material is uniform.

Method of Finding Probable Error.—Now how are we to get at truth in our experimental work? We cannot have in our ordinary experimental work 200 or 500 plots. We have to know how small a number it is safe to deal with. We therefore apply a further test to our experiment. We ought to be able to calculate out our expectancies. our belief. in the results. We know results are subject to error, but how big is that error likely to be? Mathematicians have adopted a method by which the probable error can be calculated when there are a number of experiments. The actual process is a very simple one: find the mean of results, find the difference of each result from the mean; square each difference; add the squares of the differences; divide by one less than the number of results; find the square root of that result: and that gives what is called the "standard deviation." Two-thirds (or .6745) of that standard deviation gives what we call the "probable error." By the probable error we mean that it is even betting whether any result falls inside or outside the probable error on either side of the mean. That is the treatment which every scientific man doing experiments wants to arrive at. Suppose in a comparison of Yeoman wheat with Squarehead's Master in a 10 plot experiment the mean yield of Yeoman was (say) 103.4 per cent. of that of Squarehead's Master. with a probable error of 2 per cent. This would mean that it is even betting that the real difference between the two is something more than 1.4 per cent. and something less than 5.4 per cent. The difference per cent. between the two is less than twice the probable error. That means that we must not bet on our results. We want to get the probability of our result large enough to make it safe to trust it. We can accept our results when our difference is at

least three times the probable error. Even this, of course, is not a certainty.

Let us come back to a consideration of our plots. We find, on examination, that we must expect differences of at least 10 per cent. and possibly 20 per cent. between plots that should be alike. We have to keep this at the back of our minds when we are designing our experiments, and when we are interpreting them. It is no good designing an experiment if the expected differences are less than the probable error. If the probable error is of the order of 10 per cent. then it is useless to put down an experiment to show that the superiority of A over B is 10 per cent. or not much over. Now in a great number of our agricultural experiments we cannot expect a 10 per cent. difference of yield. We are all familiar with the hundreds of experiments up and down the country, designed to compare the relative values of sulphate of ammonia and nitrate of soda as fertilisers. What good is there in putting down two such plots side by side when we know that the largest difference that we can expect in the results is only of the same magnitude as the error that we must expect in such plots? In the same way, suppose we are dealing with cereals, and are going to try to compare some of the well-known varieties; we do not expect very large differences between varieties—they do not exist. A 10 per cent. superiority of one over another is rather an outstanding difference. It will probably be more like 5 per cent. or 3 per cent. A pair of plots side by side is much too coarse a measuring machine to measure such a superiority. The casual variability is necessarily greater and no amount of skill and care on our part can reduce or obliterate it.

That is the kind of statistical idea which I think every organiser, every experimenter, has got to have at the back of his mind. He must have, first of all, in designing an experiment, an idea what degree of accuracy will be required, and next how to design his experiment so as to measure to this degree of accuracy. Plots, however, can be useful for demonstration purposes when they are of no value as measures, and we must be clear at the outset which of the two purposes they are going to serve. In designing your experiment do not ask your experimental plots a question which is too subtle. In presenting your results give an indication of the degree of confidence that can be attached to them. You do not want to tell the farmer about probable errors, but you must give him the odds on or the odds against these results being true and worth adopting in his own practice.

Uniformity of Material—Variety Tests.—I now turn to other pitfalls in experimental work. It is necessary to inquire into the uniformity of material and the origin of material, especially that used in variety tests. You may be putting down plots to compare varieties of wheat or of barley. Now the place of the origin of the seed, and the conditions under which it was harvested, make a good deal of difference to the yield, and if we are going to get our variety trials sound we have not to send for seed to a seedsman and trust to it being reasonably uniform material. We must really make an effort to see that we are getting the same stocks on all our plots, grown and harvested under the same conditions the previous year. Again, when we are dealing with variety tests we have to be extraordinarily careful that the varieties agree with the names under which we are testing. I remember barley trials in particular where the varieties were wrongly named. This caution is much needed now that trials with market-garden crops are beginning to become general. Different seedsmen give the same name to entirely different stocks. Variety testing will have to be carried out in more specialised fashion in future than in the past. Some of us have tried to tabulate the results of county and college experiments with varieties, but the mass of results examined have never seemed to lend themselves to such treatment. We came to the conclusion that the great mass of the work, while useful as demonstrations, had no value whatever as measures.

So impressed have we been of late by the fact that the ordinary plot experiment that we can put down at a farm, or even at a college or institute farm, is subject to so large an experimental error that we are setting up some six centres where we will really get very elaborate and careful measures of the standard English varieties of our farm crops. The experimental methods at these centres will be fully dealt with by Mr. W. H. Parker later on during this Conference. I may say, however, that a special drill is divided into two so that it sows two varieties side by side. The drill turns back at the end of the row so that the rows across the field are A, B, B, A, A, B, B, etc. Everybody knows that in experimental plots the outside plants are taller than those inside, because they have more space, air and water, and so forth. In these experimental plots, therefore, the outside rows are disregarded, and only the centre ones measured. In this way we can hope to reduce the experimental error to something in the order of between 1 and 2 per cent. That is to say that for that particular soil and for that season, the

two varieties can be compared with an accuracy of between 1 per cent. and 2 per cent. Well, we hope to carry on the experiments with particular varieties for at least three seasons at each of the six stations, and to set out the relative merits of the varieties with an accuracy of 1 per cent. When it has been shown that a new barley or wheat variety has a valid claim to be, we will say, 10 per cent. better than another variety, I trust that agricultural organisers will carry on the work by organising a complementary system of demonstrations. As regards demonstrations it is not worth while putting farmers to the trouble of carrying out strip or plot work; the demonstrations should be on half fields. These are much more impressive to the farmer; and points such as differences in standing capacity are brought out much better.

In all this work the Ministry appeals very strongly for the utmost co-operation between research stations, advisory officers and agricultural organisers. This is an example of the co-operation we hope to get between all branches of the research, advisory, and educational service. The agricultural organiser cannot ask the farmer to do the measurement work: this can be done by headquarters, and the organiser can pick up the results and ask farmers to do large scale demonstrations.

I conclude by reiterating that we must not expect to get absolute truth; what we can do is to collect sufficient particulars to be able to arrive at a result which is true as a whole though it may be contradicted by parts of the whole.

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THE USE OF ARABLE LAND FOR STOCK KEEPING.

JAS. C. BROWN, P.A.S.I.,

Late Vice-principal of the Harper Adams Agricultural College.

SINCE 1920 the arable land of England and Wales has shrunk by something over a million acres, the greater part of which has been added to the area under grass, in which state it can only, in agriculture, be employed in the maintenance of stock. As average land in grass has much less stock-carrying capacity than land under the plough there seems to be a good case for using, to a greater extent, arable land for the purpose of stock keeping than is the present practice. Grassland mown for hay is one of the least productive departments of present day farming; its average yield is approximately one ton of hay per acre and it extends to one-third of the total area in permanent grass. Much

of this could be replaced by the produce of arable land at no higher cost per nutrient unit than that of permanent grass hay. Cost accounts show that, where yields in the neighbourhood of one ton per acre are obtained, the cost is about the same as that of suitable arable crops, but where two tons of hay are obtained the advantage is considerably in favour of the grassland.

Comparison of Arable and Hay Land for Stock.—The following figures are taken from the cost accounts of Mr. E. D. Simons's farm and apply to very unfavourable circumstances of soil condition and situation, especially as regards the marrow-stem kale crop, which nevertheless yielded, over a field of 16 acres, 30 tons per acre. One acre yielded 43 tons but the remainder of the crop was not so heavy. It may be remarked that the crop was cultivated on a different plan to that usually employed in growing the root crop in order to take full advantage of the more hardy character of the plant. It is one of the peculiarities of the crop that it is adapted to practically any type of soil if well drained.

Cost of growing 16 acres of marrow-stem kale: estimated total yield 480 tons.

	£	s.	d.
Manual labour	107	0	0
Horse labour	84	0	0
Artificial manures	56	0	0
Seeds	10	0	0
Rent and rates	32	0	0
Depreciation of implements ...	7	0	0
	£296	0	0

Average cost per acre £18 10s.

The cost per lb. of starch equivalent when kale is taken to contain 8.8 lb. per 100 lb. is 0.75d.

The cost per acre of growing the mixed grain crop was as follows:—

	£	s.	d.
Manual labour	2	2	0
Horse labour	2	4	0
Artificial manure	0	15	0
Seed	2	1	0
Rent and rates	2	0	0
Depreciation of implements	0	8	0
	£9	10	0

For 25 cwt. of grain made up of $12\frac{1}{2}$ cwt. of peas and beans, $6\frac{1}{2}$ cwt. of barley, 6 cwt. of oats and 35 cwt. of mixed straw the cost per lb. of starch equivalent is 0.86d.

The cost of growing the mixed crop on a lighter soil was £7 17s. 2d. per acre and of a similar crop on light soil and cut green at the Leeds University £5 18s. 7d. This last figure does not include harvesting.

The cost per acre of the hay crop was :—

	£	s.	d.
Manual labour	1	0	0
Horse labour	0	9	4
Rent and rates	1	17	4
General expenses	0	0	4
Depreciation of implements	0	8	0
	£3	15	0

Assuming a 25 cwt. crop, and the aftermath and winter grazing to have a value equal to $\frac{1}{3}$ of the hay crop the cost per lb. of starch equivalent is 0.8d.

One acre of marrow-stem kale—30 tons—yielded 5,913 lb. starch equivalent. One acre of mixed grain—3 tons—yielded 2,644 lb. starch equivalent. One acre of hay and grazing—$1\frac{2}{3}$ tons—yielded 1,120 lb. starch equivalent.

Thus, theoretically, the kale provided maintenance for one average dairy cow for 844 days, the grain mixture for 377 days, and the hay and grazing for 160 days.

As regards pasture land, if rent, rates, taxes, manures and cultivation be taken at £2 10s. per acre for land pastured, and if two acres of such land be required to maintain one dairy cow giving two gallons of milk daily for 26 weeks, the cost per lb. of starch equivalent obtained from grazed land is 0.6d.

In addition to the greater quantity of fodder obtained there is also some advantage not shown by accounts in keeping land under the plough, in view of the variety of produce it enables the farmer to market. Grass gives stock products only. At a time when it is necessary to produce food for stock at the lowest possible cost it may be of use to examine what class of arable farming, if any, can compare in cost of production of food for stock with average grass, which has recently been under the plough. It may be accepted that the only department of arable farming which is as effective in this respect through the summer period as pastured permanent grass is the temporary ley, because of the labour involved in all other methods of feeding stock from arable land. There are, however, only about 14 weeks of really effective grazing in the year, except in specially favoured circumstances. The

writer is not aware that any figures are available showing the output of grassland month by month throughout the year, but obviously on average land, after midsummer, yield falls off rapidly. Much grassland is occupied in the bare maintenance of life or in adding very little to the weight of animals grazing on it. The progress of stock at this time can be maintained by supplementing the grass by fodder grown on arable land, but this, of course, adds to the cost of summering such stock and it is not possible to say without comparative tests whether the increased gain is sufficient to cover the cost of the extra food supplied. When it is a matter of maintaining the largest possible head of stock a succession of arable crops with double cropping gives the best results, but owing to the heavy labour bill involved, this system in its completeness, cannot be practised profitably, under average conditions, at the present time. Only under favourable conditions will the returns be sufficiently good to cover the greatly increased expenditure of handling by manual labour the whole of the food required by stock. Experience has shown that, under present conditions any successful system of arable stock farming must include a grazing period to cover the most productive period of the summer months.

Temporary grass has been very successfully used for grazing in the North of England. Temporary grass is generally believed to be less valuable for grazing purposes than permanent grass, but no definite information exists to show that this is so, and the writer has often observed that cattle having a choice of the two kinds have preferred the newer pasture. From the farmer's point of view temporary pasture has an attraction, in that when heavily stocked it is being brought to a high pitch of fertility suitable for the growing of profitable crops of cereals, whereas fertility may accumulate in old pasture and have little immediate value. With the recent rise in the price of corn and feeding stuffs it is open to question whether the present tendency to return land to grass is likely to be more profitable than a change of practice in the management of plough-land aiming at supporting a larger head of stock, and at the same time, providing concentrated feeding stuffs on the farm and also some grain for sale. Experience has shown that the labour on stock and the cost of feeding must not greatly exceed that of the grass farm if a profit is to be reached at present prices.

Cost accounts have shown, however, that under extremely adverse conditions when arable land is suitably and economically

cropped nutrients can be produced as cheaply as on average permanent grass mown for hay. Recent experiments on an extended scale show that several arable crops can be used effectively in the place of hay, and from three to five times the quantity of starch equivalent produced per acre at no greater cost per unit. For winter feeding the produce of arable land is as economical as that of average grass. There remains the further possibility of increasing the efficiency of the farm by supplementing the produce of the pastures from the arable land after the flush of grass is over. By this method the early summer rate of increase can be maintained. It is possible that silage may be the best food for this purpose, and it remains to be shown by actual comparison with grazing whether ensilage can be made profitable, but throughout the whole country it is obvious that much time is lost by stock remaining almost stationary in growth during late summer and autumn.

Crops for Stock Feeding on Arable Land.—(1) *Marrow-Stem Kale.*—Practically every crop suitable for stock feeding has been tried in the writer's experiments, and the following stand out as the most reliable and suitable for the purpose. Marrow-stem kale is placed first because no other crop that can be grown in England will produce so much nutrient matter per acre, few crops are so reliable and none more relished by cattle or sheep. It has many advantages over the popular root crop. In the first place the labour on the crop need not be more than half that required for roots. The plant contains much more protein and lime than the root crops, and its response to generous manurial treatment is more sure. This crop is best grown on the kale garden plan, continuously on the same land, which has been raised to the highest possible pitch of fertility. It is of course essential that such land be well supplied with lime and mineral manures in addition to all the farmyard manure which can be spared for the crop. If well drained, almost any land will, treated in this manner, give heavy crops. It is much easier to grow 40 tons per acre of this crop than of any other available to the British farmer, and it pays to treat it well because it never fails to respond.

The crop can be obtained forward enough to feed in October and is useful until the end of February or later. It is so variable in type, however, that by selection and hybridisation the period of usefulness could be extended to cover the whole year if necessary: its possibilities remain largely unrealised. Its

winter hardiness has, however, been much improved since its introduction. Marrow-stem kale is more nearly a balanced food than roots, and can be successfully fed in larger quantities than it is advisable to feed roots. Whether, however, it is better practice to give smaller quantities and to balance the ration with concentrated foods is a matter of opinion. It seems mainly a matter of which gives the cheaper supply of nutrients. By crossing this plant with perennial forms of kale the writer is of opinion that by such means the ideal crop for supplementing pasture in the late summer months could be obtained.

(2) *Mixed Corn.*—Next to marrow-stem kale in usefulness is a mixture of beans, peas, barley and oats, which stands out superior to any other arable crop in its reliability and the ease with which it can be grown. It has a wide range of adaptability to soil conditions and can be grown with success even on light soils if farmyard manure and phosphates be supplied. The mixture was first grown by the writer for feeding green, for which purpose it is excellent, but it may also be made into silage or harvested as a corn crop, in which form it is of the greatest use in stock feeding. When grain was cheap the whole crop was cut into chaff and fed with marrow-stem kale: this plan saved the cost of thrashing but was obviously wasteful, though less so than might be imagined. The best way to use it is to thrash the crop and grind the grain to meal and feed the straw long in conjunction with marrow-stem kale, a very satisfactory ration being 50 lb. marrow-stem kale, 12 lb. mixed straw, and $2\frac{1}{2}$ lb. meal of the mixed grain. Unfortunately, the seed mixture as given above cannot, without risk, be sown earlier than 1st November. If sown in September or October vetches must be substituted for peas. So far the writer has not discovered a variety of peas which, when sown early in the autumn, will withstand severe winter conditions, although a few plants will always survive. Winter varieties were known in the past but seem to have been lost, which is to be regretted as autumn-sown peas are much less subject to failure in excessively dry or wet summers than those spring sown. In the writer's experience Leighton Early winter pea has stood the winter best, and there can be no doubt that the winter-hardy character could be recovered, and also varieties could be raised which would be much better suited than the present field peas to forage cropping purposes. Probably something could be added to the rate of gain of

stock by increasing the proportion of leguminous plants in their bulk food in view of the greater quantity of lime salts carried by these plants in comparison with other species. For the months October to February the kale and mixed-crop fodder mentioned above probably forms the cheapest effective winter feed available. It is probably a good deal cheaper than silage and at least equal in effectiveness, but in our uncertain climate the drying of the grain is a consideration. When grown continuously on the same land the grain mixture crop has much the same effect on the soil as a temporary ley and forms a good preparation for a wheat crop. The chief reason why cereals cannot be successfully grown continuously on the same land is that they destroy the texture of the soil: mixtures of grain containing peas and vetches, mellow and pulverise the soil. It is necessary to see that the soil is well stocked with potash and phosphatic manures and lime when the above crop is grown continuously. The possibility of growing a grain crop continuously on the same land without the excessive use of manures or employing a bare fallow is of considerable importance in that it offers an inexpensive plan for keeping land under the plough. It might even be possible to grow wheat continuously by mixing it with beans and peas, easily separated in the thrashing. The condition of the soil is rapidly improved by the roots of the leguminous plants, while the increase in the weight of the crop due to the mixing is quite remarkable. The writer arranged several tests of this mixture against pure cereals with manures, and while it was doubtful from observation whether the manures had any effect on the crop, the effect of the mixing was unmistakeable: the crop looked double the weight of the cereal and could not have been less than 50 per cent. heavier. Peas and beans are a traditional preparation for cereals, and their effect is equally beneficial when the plants are growing side by side.

The crops described greatly increase the stock-carrying capacity of a farm and all are inexpensive to grow and produce nutrients at as low a cost as hay from permanent grassland. There is also a further aspect of this class of cropping. England still has over 300,000 acres of bare fallow, a large part of which could be profitably cropped with the grain mixture described above. On well-drained land nearly every kind of weed can be destroyed by autumn-sown smother crops. In fact these crops have much the same effect on the land as fallowing, killing out the weeds, improving the soil texture, and rendering its condition suitable for carrying a cereal crop. The grain mixture

is specially suited to land on which bare fallow still forms part of the usual practice. Success in obtaining a smothering condition depends on getting a dense plant early on the ground: deep ploughing is the first step, accompanied by generous manuring; then early autumn sowing as soon as possible after ploughing and the inclusion of vetches in the mixture if the land be very weedy. Where the land is comparatively clean to commence with it will easily maintain its condition when cropped continuously with the mixed grain crop.

Cultivation of Mixed Corn.—The mixed crop differs from the pure cereal crop in that the leguminous part of it fills up the spaces between the upright cereal plants and prevents light and air reaching the ground: the mixture of leguminous and cereal plants more closely resembles the natural herbage of a pasture, while the soil condition remaining when the crop is removed is quite different from that left by a pure cereal crop. In a recent test, in which three successive crops of the mixture were grown on land choked with perennial weeds, the only perennial weed not destroyed was the dock, which owing to large reserves of food material, held in the root, is able to survive and overtop even the densest crop.

The crop can be sown at any time from October to March; under most conditions it succeeds much better sown in the autumn. If sown before 1st November the seed mixture should be composed of 2 bus. beans, $\frac{1}{2}$ bus. vetches, 1 bus. winter barley, 1 bus. winter oats per acre. If sown later than this date it should be made up of 2 bus. beans, $1\frac{1}{2}$ bus. field peas, $1\frac{1}{2}$ bus. winter barley and 1 bus. winter oats, sown at the rate of 4 bus. per acre. The quantity of seed required depends on the character of the land—in some cases it may be reduced to 3 bushels, while on some of the poorer soils it is advisable to increase the seeding to 5 bushels. It has always been the writer's practice to sow the mixed seed on the raw furrow and to cover the seed with the spring-tined harrow, giving no further cultivation. On light soils it is possible that rolling might also be needed. A dressing of 5 cwt. to 8 cwt. of basic slag and 2 cwt. of kainit seems to be the most suitable manurial treatment. On light soils the crop is greatly benefited by dressings of farmyard manure, but on the heavier soils artificial manures alone will give full crops. One of the chief uses is the smother effect of the crop, which depends on a full growth being obtained, so that the necessary manure should not be withheld.

The method of ploughing the land is of great importance in securing the destruction of weeds. On heavy soils deep

ploughing is necessary to get good results. It will be seen on examination that the roots of perennial weeds exist mainly in the surface five inches of the soil. By ploughing deeply and using a large skim coulter the greater part of the roots of the weeds can be buried and several inches of soil free from weeds got up to the surface. In this soil the seed of the crop can establish itself in advance of the buried weeds. If it fails to do so the smothering will be incomplete. The beans and peas grow away in advance of the cereal portion of the crop and flower, and form pods before being covered over by the grain crop; thus the density of the mixed crop does not interfere with seed development. Also, the mixture appears to be less liable to insect and fungus attack than either of the crops grown separately.

Other crops can be employed where the land is suitable; thus rye can be used as a hay crop and followed by turnips. It is not generally known that rye, when cut very early, makes a very nutritious hay of which stock are particularly fond. A mixture of wheat and peas, autumn sown and cut when the peas are in flower, makes excellent hay, as also does a mixture of vetches and winter oats autumn sown. Where land is not subject to frit fly a mixture of peas and oats is the best crop for sowing in the spring to harvest as a hay crop. If it is intended to harvest for seed, beans must be included in the mixture as otherwise the crop will, if heavy, be very liable to become laid before it is sufficiently ripe to cut. The hay from the mixtures named is not more difficult to make than seeds hay, but requires time in the field. It used to be the writer's view that it was the best plan to put the mixture early into large cocks, but there certainly is a case for leaving it in rows and turning each day whether dry or wet. The grain mixture has in most cases many advantages over the other crops described. The almost complete absence of risk in growing this crop, and the many uses to which it can be put, render it best suited to compete with grassland at the present time, and there are few farms where it could not be tried with advantage. Instead of seeding more land down to grass the following rotation is suggested, which, so far as the experiment has gone, the writer has found successful on an intractable soil.

1, 2, 3, 4—beans, peas, barley and oats' mixture; 5—wheat; 6—oats; 7—clover; 8—wheat.

This arrangement gives seven-eighths of the land under corn with greater certainty of securing a heavy crop of clover hay or

forage in the remaining year. The grain mixture crop is a good preparation for wheat, especially so if the crop be cut green. The green forage required is kept out of this rotation, being grown separately as previously described, so that the grain does not have to carry part of the loss on the root crop as in the case of the four-course rotation.

To carry out the above scheme about one-third of the area of the farm is needed in grass, either temporary or permanent, but the most suitable proportion will be determined to some extent by the character of the farm concerned.

The above scheme can be applied to much of the land which is being laid down to grass, and as the unprofitable root crop is eliminated and high yields of mixed corn can be obtained, while the condition of the land is improved and no bare fallow is required, in many cases land should give a more profitable return than from grass. The success of arable stock farming in England depends on the production of nutrients at as low a cost as they can be provided by grass and in converting them into meat or milk as cheaply. The necessity of keeping costs down to this level makes it impossible to intensify stock farming up to the full limit of what the land can carry, but it would appear that given a suitable system there is no reason to suppose that grass is the only solution to the present-day problem with which the land is faced.

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LIVING CONDITIONS OF HOP-PICKERS IN KENT.

AT a recent meeting of the Council of Agriculture, the Ministry was urged to take some action with a view to the improvement of the conditions of employment of women and child labour on the land. As a first step, after consultation with the Ministry of Health, it was decided that it would be of advantage to draw attention to the conditions of employment in the Kent hop-fields. It is hoped that hop growers will co-operate with local authorities in securing a reasonable standard of decency and comfort for the temporary workers employed in the hop-picking season.

An instructive account of the lodging and accommodation of hop-pickers and pickers of fruit and vegetables was prepared in 1907 by Dr. Reginald Farrar, one of the Medical Inspectors of the Ministry of Health, and Dr. Farrar's report still remains the standard work on the subject.

The report pointed out that there was a tendency for the smaller farmer to be squeezed out by the bigger grower, and that the crowding out of the small farmer had a bearing on the labour conditions since, while the small employers can often not afford adequate provision, the big employers " regard, or should regard, such provision as part of their capital outlay."

Dr. Farrar classified hop-pickers as " home " (*i.e.*, local pickers), " foreign " (*i.e.*, " imported ") pickers, gipsies and casual vagrants He estimated that no fewer than 100,000 " foreign " pickers and " half " pickers, in addition to younger children to the number of probably not less than 50,000, migrate into the hop-growing counties during the hop harvest. He drew attention to the congestion of casual wards during the first and final weeks of the hop-picking season, since the poorer hop-pickers treat them as houses of call *en route* to and from the hop districts. Dr. Farrar describes some of the better types of housing provision, and concludes by saying that, while " the accommodation provided for hop-pickers affords ground for serious complaint in particular instances it is only fair to record that this accommodation is not, on the whole, generally unsatisfactory." He adds, however, that " bye-laws should be adopted in any district in which hops are grown on an extensive scale, and that the Board's model bye-laws represent the minimum standard in respect of health, decency and comfort for hop-pickers."

Many changes have taken place since the date of the above report, and the area under cultivation is now not much more than one-half what it was in 1907. Picking is, however, still mainly done by hand, and there are as yet few indications that picking or stripping by machinery is likely to be generally adopted in the near future. So, for the short period (normally one month) that hop-picking lasts, a considerable volume of labour is still needed, and the fact must be faced that it is likely to be less easy in the future to obtain suitable labour than it has been in the past. The tendency of present-day legislation is to curtail the employment of child labour and to " de-casualise " adult labour, so that in order to attract the workers required not only improved wages but improved conditions while at work are necessary both in the interests of the employer and the worker.

Following these preliminary remarks, a short account may be given of the hop-picking conditions prevailing in Kent at the present time.

There is, of course, considerable variation in the size of hop gardens in the county. There are a number of small hop gardens on the outskirts of towns employing purely local labour to the number of 100 or so. Here practically no difficulties arise since the employees are within easy reach of home. Such work is particularly prized by the married women who are able, with the assistance of their children, at little practical inconvenience to themselves to supplement the family income. The larger gardens, employing anything up to 1,000 pickers, also in some cases depend on local labour but draw it from a greater distance: the remainder depend on "imported labour," the real problem of Kent. Accurate figures are hard to come by, but it is generally agreed that upwards of 70,000 people (chiefly women and children) migrate annually from London into the Kentish hopfields. This is a serious matter from every point of view. It not only affects the grower and the worker, but has reactions on local life. And, though the duration of the invasion is limited, the fact that it is of yearly occurrence makes it of importance and justifies the growing demand for more effective regulation.

The same labour is normally engaged by the growers year after year, and the engagement is effected directly or through an agent of the farmers. In the past, transport has also been arranged individually, but the establishment of the Mid-Kent Hop-pickers' Welfare Committee, some two years ago, has already effected appreciable changes in this direction. With the co-operation of growers, workers, and the railway company, a system is being evolved which will permit of the workers being brought on the scene at the required moment and with the minimum inconvenience to themselves. The congestion of workhouses, of which Dr. Farrar complained, should, therefore, no longer occur, and the overcrowding, the delays, the unsuitable hours of departure and return, which resulted in much inconvenience to "the hoppers" will, it is hoped, shortly be past history. Minor transport troubles are yet to be finally solved, including in some cases, the conveyance of workers from the station to the farm, but a great improvement has already been effected, to the relief of all concerned, including residents in the locality.

The question of accommodation for the "Londoners" remains, however, the concern of the individual farmer, and there are very great variations of standard. Some admirable arrangements can be seen in the case of certain large growers. Well laid-out camping grounds, with wooden huts partitioned into

sections or cubicles, are a feature of such places. Drinking water and earth sanitation are provided. There are common cook-houses and facilities for procuring food. Medical assistance is available, and all the requirements of a well-conducted camp are met. Correspondingly good arrangements are made by many smaller growers.

But it remains true that these are the exception rather than the rule. In view of the general advance in social conditions, the prevailing standard leaves much to be desired. Dirty and untidy camps, with overcrowded huts, with deficient or unsuitable sanitary provision, and with unsatisfactory cook-houses are still far too common. On the other hand drinking water is now more generally available than was formerly the case. When every allowance is made for difficulties created by the pickers themselves it remains true that the *average* accommodation provided for them has not kept pace with the time and falls short of those minimum requirements which may be reasonably required for such temporary housing.

Where *imported* labour is concerned and where housing has to be provided in large barracks and encampments, experience suggests :—

(*a*) that the number of residents should bear some definite relation to the amount of floor space and cubic space in sleeping compartments;

(*b*) that water for drinking and cooking purposes should always be available;

(*c*) that sanitary and ablution huts should be included in the compound, and definite arrangements be made for their cleanly maintenance;

(*d*) that cook-houses should be provided;

(*e*) that premises should be repaired and disinfected between seasons;

(*f*) that the owner should be required to provide the services of a camp superintendent;

(*g*) that where no suitable voluntary organisation exists there should be some call on the services of a local doctor or nurse, or both;

(*h*) that pickers should be encouraged to assist in preventing overcrowding and maintaining cleanly conditions.

Local authorities have it in their power to do a good deal to assist in this matter. The legal position is that by the Public Health Act of 1875 and the Public Health (Fruit Pickers' Lodgings) Act of 1882, local authorities are empowered to regulate the action of those *providing* accommodation by making

bye-laws for securing the decent lodging of persons engaged in the picking of fruit, vegetables and hops. They also have power to regulate the action of those *occupying* such accommodation by making bye-laws under Section 9 of the Housing of the Working Classes Act of 1885. The Ministry of Health has drawn up model bye-laws for the guidance of local authorities, and it is understood that these bye-laws are under revision at the present time. A number of local authorities have made bye-laws, but the difficulty is that, even when made, they are often inadequately enforced.

The question from a legal point of view is essentially a matter for the local authorities concerned, but from a practical point of view it is well deserving of consideration by the employers. Points which were particularly noticeable last year were the failure to cleanse the camps before the pickers arrived, and the neglect of efficient scavenging during occupation. It is obviously the duty of the employer to see that the camps are kept in a reasonably sanitary condition. This can only be done efficiently by providing paid workers to undertake the work daily. Possibilities of this kind were indicated in an article on "The Housing of Casual Labour" in this *Journal*, February, 1924, p. 1017.

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ENSILAGE.—VII: THE FEEDING OF SILAGE.

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IN the previous article of this series* Dr. Woodman has described certain of the changes which occur during the conversion of a green crop into silage, and indicated how variable may be the quality of the product according to the conditions prevailing in the silo. He has also shown that the feeding value of the silage varies with the quality, that in one case the value of green fruity silage was to the acid brown type as 7 is to 5, and that sweet silage made at too high a temperature may be rendered much less digestible than if made at a lower temperature.

* "Chemistry of Silage," this *Journal*, May, 1925, p. 124.

It is a point of first importance in considering the feeding of silage to realise that it varies very greatly in quality. The green fruity type, when successfully made, undoubtedly has the best feeding value, but the conditions under which it can be made are none too well known at present and a slight misjudgment may result in the production of sour silage. Acid brown silage can be easily and surely made and is the next best in value. Sweet silage is very palatable, but like over-heated hay has become less digestible and if fed in excess may cause some scouring. Sour silage, if only slightly sour, may be good feed, or on the other hand the amount of butyric acid present may be so great that stock will refuse to eat it and men to handle it.

In addition to the quality of silage as indicated by the character of the acids produced there is another important respect in which quality varies, namely, in the variety of the crop or mixtures of crop ensiled as well as quality of the crop itself. In the silage boom during the period 1880-90 many people believed that it mattered little what was put into the silo: it would all become good silage. Nothing could be further from the truth. The character of the crop ensiled is most important.

All sorts of crops and mixtures of crops are now being ensiled, *e.g.*, grass, "seeds" mixtures, mixtures of cereals with legumes and maize, and beyond this the different degrees of maturity of the crop ensiled all have their influence upon the food value of the silage. One or two outstanding points may illustrate these influences more clearly:—rye is sometimes used in mixture with tares: this almost invariably becomes old, fibrous and indigestible before ensiling and consequently such silage is disappointing in its feeding properties; similarly, if for any reason the tares or other legumes fail to produce a fair proportion of the crop, and the oats and other cereals form the greater part of the silage, then the resulting silage is less palatable and less digestible. On the other hand it is a matter of observation, when a mixed silage of legumes including tares and beans with cereals is fed to sheep or other animals, that these pick out the leguminous portions in preference to the cereal straws. The food value of such mixed silages will, therefore, vary greatly with the relative proportions of cereal and legume, as also with the proportion of seed and fruit to leaf and straw of each constituent plant. Maize silage is very different in chemical analysis and feeding properties from the mixed cereal and legume silage, and when grown in this country the maize generally has few cobs and is rarely sufficiently

mature for correct ensiling. In view of these wide variations in crops for ensilage the further discussion of silage feeding in this article, unless otherwise stated, will refer only to mixtures of oats with the legumes, tares, peas and beans. The foregoing paragraphs have shown how widely silage may vary from the point of view of the crop materials from which it is formed. Analysis of the moisture content indicates another important variable. Oat and tare silage has been found to vary from as much as 80 per cent. of water to less than 60 per cent., and when attention is diverted from moisture content to dry content of silage it will be seen that this varies from 20 per cent. to 40 per cent.; in other words, the silage containing 80 per cent. of water contains only one half the food value of silage containing 60 per cent. of water. This is very important to bear in mind in rationing and still more important in conducting demonstration trials and experiments in feeding, especially when it is realised that the percentage of dry matter may vary greatly within a depth of a few feet in the silo. In order to define a standard in this matter, the writer has regarded silage containing 70 per cent. moisture (*i.e.*, 30 per cent. dry matter) as standard silage; and in practice it is found that the average of analyses of many samples of oat and tare silage made in the comparatively dry area of the Eastern Counties is close to this standard. In moister districts the average per cent. of moisture is probably nearer 75.

A farmer when commencing to produce and to feed silage always wants to know with what other farm crop he may compare it, and in particular how it compares with roots. He grows it as a substitute for roots: how far can he feed it as a substitute? From the analytical point of view silage is succulent; roots are succulent, containing 85 to 90 per cent. moisture and green crops are also succulent, containing generally 70 to 85 per cent. So far the comparison between roots and silage is reasonably close, but the following table giving the composition of the dry part in each of four foods shows that the similarity stops at this point.

TABLE I.—COMPOSITION OF DRY MATTER.

	Mangolds.	Green Oats and Tares.	Oat and Tare Hay.	Oat and Tare Silage.
Crude Protein	8.7	10.8	13.9	12.5
Nitrogen—free Extractives = Carbohydrates	78.0	50.2	45.8	45.6
Ether Extract = Fat, Chlorophyll, Acids	0.8	3.0	2.0	4.3
Crude Fibre	6.0	28.1	29.0	29.4
Ash	6.5	7.8	9.1	8.1

A glance at the table is sufficient to show that the food contained in oat and tare silage does not compare closely with that contained in mangold. The former contains nearly 50 per cent. more protein. Mangolds contain nearly twice as much carbohydrate as silage and, since in mangolds these are chiefly in the form of sugar, they are more easily digestible. The ether extract shows 5 times as great a quantity in silage as in mangolds; this difference is due largely to the presence of the acids in silage, the full significance of which in the food is not known. Silage contains nearly 5 times as much crude fibre as mangolds, a most important difference, since this has a large influence upon the rate of passage of the food through the bowels of the animal. Roots are generally fed to cattle in conjunction with some roughage, straw or hay, but it is not so important to feed such roughage with silage and impossible to feed it in so large a quantity. On the other hand the table shows that silage compares closely in the analysis of its dry material with the green crop from which it is made and with hay made from the same green crop. In feeding silage therefore, it seems advisable to compare it not so much with roots as with the green crop from which it was ensiled or, except as regards succulence, with hay made from a similar crop. None the less because silage is grown in the place of roots and because the farmer is keen to know the answer to the question: "How does silage compare with roots in feeding value?" a number of useful trials have been carried out by Oldershaw in East Suffolk,* by Rae at Oaklands, Herts,† by Drew at Glasnevin,‡ and by Sheehy and Delaney at Athenry,§ which in general show that well-made silage gives as good results or perhaps slightly better than the analysis suggests.

The trials by Drew at Glasnevin are perhaps the most comprehensive of those yet published and part, at any rate, of the difficulty of designing a simple experiment for comparing foods so widely different in composition as roots and oat and tare silage has been overcome by feeding silage and some hay on one side of the experiment, against roots and extra hay on the other side; this plan serves to overcome part of the differences due to fibre-content in the two foods, but does not attempt to balance other food constituents.

* Oldershaw. Journal of Board of Agriculture. Vol. XXIII, June 1916.
† Rae. Bulletin No. 2. Herts. Institute of Agriculture.
‡ Drew. Journal of Irish Dep. of Lands and Agriculture. Vol. XXIV, No. 3.
§ Sheehy and Delaney. Journal of Irish Dep. of Lands and Agriculture, Vol. XXIV, No. 2

None the less the results are very informative, and are quoted below.

In one case 28 bullocks for fattening were divided into 4 pens and fed the following rations :—

Silage. Lot No. I.	*Roots.* Lot No. II.
30 lb. Silage.	50 lb. Roots.
$3\frac{1}{4}$,, Palm Nut Cake.	$3\frac{1}{4}$,, Palm Nut Cake.
$3\frac{1}{4}$,, Oats.	$3\frac{1}{4}$,, Oats.
17 ,, Fodder.	$18\frac{1}{2}$,, Fodder.
Lot No. III.	Lot No. IV.
50 lb. Silage.	84 lb. Roots.
$2\frac{1}{4}$,, Palm Nut Cake.	$2\frac{1}{4}$,, Palm Nut Cake.
$2\frac{1}{4}$,, Oats.	$2\frac{1}{4}$,, Oats.
10 ,, Fodder.	19 ,, Fodder.

The silage was made from a crop seeded with 12 stones of beans, 6 stones of oats, 3 stones of peas and 3 stones of tares. The roots were mangolds. In compounding the ration 6 lb. of silage were regarded as being equivalent to 10 lb. of roots, but it is significant that the dry food content of the silage is not stated. Palm nut cake and oats were fed equally to Lots I and II and to Lots III and IV and fodder was fed *ad lib.*, weighed and the amount actually consumed recorded and stated in the above rations.

The trial lasted 82 days with the results shown in the following table—

TABLE II.—LIVE WEIGHT INCREASE ON SILAGE AND MANGOLDS.

	Average Live Weight Increase. cwt.	qr.	lb.	Average Daily Increase. lb.
Lot I. Silage ...	1	3	4	2.44
,, II. Roots ...	1	3	25	2.69
,, III. Silage ...	1	2	4	2.09
,, IV.* Roots ...	1	1	16	1.90

Comparing Lots I and II there is a daily gain of .25 lb. in favour of mangolds, but this gain is put on at a cost of $1\frac{1}{2}$ lb. of extra fodder. On the other hand in comparing Lots III and IV there is a daily increase of 0.19 lb. in favour of the silage group, though the root-fed bullocks consumed an extra 9 lb. per head per day of fodder. The suggestion of Drew that 6 lb. of silage is equivalent to 10 lb. of mangolds and some fodder is supported by these trials.

In the same publication Drew describes a similar trial with 14 dairy cows divided into two groups receiving the following rations :—

Ration I.	Ration II.
50 lb. silage	84 lb. roots
3 ,, palm nut cake	3 ,, palm nut cake
3 ,, oats	3 ,, oats
11 ,, hay	14 ,, hay

The rations again provide the comparison between 6 lb. of silage and 10 lb. of roots plus some hay.

The trial period lasted for two periods of 6 weeks between which the rations were changed over, allowing a transition period of 14 days to elapse whilst the cows settled down to their changed rations. Table III gives the average weight of milk and percentage of fat at different periods during the trial:—

TABLE III.—SILAGE VERSUS MANGOLDS FOR MILKING COWS AT GLASNEVIN.

		Prelim. Period.	Silage Ration.	Transition Period.	Root Ration.
Group A	Yield of Milk ...	25.8	21.7	19.2	18.7
	Percentage of Fat	4.20	4.02	—	3.87
		Prelim. Period.	Root Ration.	Transition Period.	Silage Ration.
Group B	Yield of Milk ...	25.4	21.5	19.4	19.1
	Percentage of Fat	4.22	4.24	—	4.10

The above figures show great uniformity and suggest equality of feeding value between the two rations for the production of milk, and still further support Drew in his view that 6 lb. of his silage can be used to replace 10 lb. of roots and some fodder in the rations of cattle, a view which is in general agreement with other trials and supported by farmer's experience.

Several series of experiments have been carried out at Cambridge during recent years, but these have for the most part been designed on rather a different plan in order to avoid comparing two such dissimilar foods as silage and roots. In the three winters 1920-21, 1921-22, and 1923-24 the basis of comparison has been equal dry weights of oat and tare hay with oat and tare silage made from the same crop mixture, each lot of cattle receiving in addition equal weights of straw chaff, roots and meal. As an example, in 1921-22, 16 young cattle aged 18 to 21 months, were selected from a bunch of 20 and divided as carefully as possible into two lots of 8 each. At the beginning of the experiment, 24th November, they were gradually brought on to the following rations:—

	Hay Ration.	Silage Ration.
Oat and Tare Hay	8 lb.	Oat and Tare Silage equal in dry weight to 8 lb. hay
Straw Chaff	3 ,,	3 ,,
Kohl Rabi	14 ,,	14 ,,
Bean Meal	1½ ,,	1½ ,,
Barley Meal	1½ ,,	1½ ,,

The actual weight of silage fed varied from time to time according to the percentage of dry food it contained. At the beginning of the experiment the hay contained 88.9 per cent. of dry matter and the silage 30.6. The equivalent dry weight of silage to 8 lb. of hay was therefore $8 \times \frac{88.9}{100} \times \frac{100}{30.6} = 23.2$ lb. The moisture in the silage was determined once per week and the ration recalculated after each determination. The rations were compounded and fed in such amount as the cattle should easily clear up, but as the animals grew and their appetites increased the rations were also increased. Thus on 28th December the straw chaff was increased to 4 lb. per head, and on 23rd February the hay was increased to 10 lb. on one side of the experiment and on the other side the quantity of silage was increased proportionally.

The cattle were brought to the experimental rations on 24th November and after a preliminary fortnight were weighed on 8th December, when the experiment proper commenced. The first part of the experiment lasted 63 days, until 9th February, when the cattle were weighed again. Then between 9th and 23rd February the rations were gradually reversed so that those cattle receiving hay were put upon the silage ration and vice versa. The second part of the experiment lasted 49 days until 13th April, when the cattle were weighed for the last time.

The quality of the silage fed during the experiment was good, except for a few days at the beginning of the first period when the silage had undergone a slight secondary fermentation after the silo was opened; for the greater part of the time it was of the green fruity type. The hay also, having been cured during the dry summer of 1921, was very good.

TABLE IV.—RESULTS OF FEEDING EXPERIMENT, 1921-22.

		Average Initial Weight.			Average Final Weight.			Average Increase.		Average Daily Increase.
		cwt.	qr.	lb.	cwt.	qr.	lb.	qr.	lb.	lb.
					1st Period—63 days.					
Lot I.	Silage	5	2	12	6	2	4	3	20	1.65
Lot II.	Hay	5	2	8	6	1	13	3	5	1.41
					2nd Period—49 days.					
Lot I.	Hay	6	3	6	7	1	7	2	1	1.16
Lot II.	Silage	6	2	25	7	1	20	2	23	1.61

The table shows that during both periods the cattle fed upon silage increased in weight more rapidly than those fed upon hay. In the years 1920-21 and 1923-24 similar experiments were carried out, in the former year with 12 bullocks and in the latter with 8 bullocks in each lot.

TABLE V.—FEEDING EXPERIMENTS WITH CATTLE. OAT AND TARE SILAGE VERSUS OAT AND TARE HAY WITH 56 CATTLE DURING 3 YEARS.

Year.		Duration of Period.	No. of Cattle in each Lot.	Average daily Increase. On Silage.	On Hay.
1920-21.	1st Period.	49 days	12	1.63	1.00
,,	2nd Period.	41 ,,	12	1.17	1.10
1921-22.	1st Period.	63 ,,	8	1.65	1.41
,,	2nd Period.	49 ,,	8	1.61	1.16
1923-24.	1st Period.	60 ,,	8	1.57	1.01
,,	2nd Period.	42 ,,	8	1.81	1.26
Average daily increase all periods	...	...	...	1.56	1.15

In the year 1920-21, the silage fed during the first period was of the acid brown type, but passed gradually into the sour type towards the end of the second period; this probably explains the small gain in weight of the silage cattle in this period; the oat and tare hay in 1920-21 was slightly overmature containing occasional half-formed pods with tiny seeds, not all of which were properly digested, otherwise the hay was good. In 1923-24 the silage was good throughout and varied in quality between the acid brown type at the top and the green fruity type at the bottom. The hay was good as regards maturity and stack management, but had lost some of its natural aroma by reason of a small amount of rainwash.

As shown in Table V the average gain in weight per day over all the three years' experiments for the cattle fed on silage was 1.56 lb. as compared with a daily gain of 1.15 for the cattle when fed upon hay, showing an advantage of 0.41 lb. per head per day. This in a winter feeding period of six months would mean a difference of 75 lb. per head in favour of silage.

This difference may be due in part as in 1920-21 and in 1923-24 to the inherent difficulty in making first class oat and tare hay, but it also indicates how good a food well-made oat and tare silage is for growing cattle. This is shown especially in 1921-22 when the hay was really first class. It seems fair to draw the conclusion that well-made oat and tare silage in comparison with well-made hay is worth more for feed than a comparison of their dry weights suggests, and this is borne out by Woodman's experiments upon the digestibility of the two foods. On a dry weight basis with " standard " silage containing 70 per cent. of moisture and hay containing 15 per cent. of moisture, 100 lb. of silage would be equivalent to 35 lb. of hay, so that in view of the above experiments it seems fair to assume

* Woodman. J. of Agric. Science. Vol XII, Part II.

that 100 lb. of good silage may be equivalent in food value to between 35 and 50 lb. of hay according to the quality of each.

Special Uses of Silage as Food of Stock.—(1) Some foods, as for example mangolds and hay, require to be kept for a certain time before they are fit for consumption, while roots can only be kept a limited time. The fermentation changes in silage are completed very rapidly and silage is fit to feed within 10 days of making. In the summer of 1924 two 9-months old steer calves were fed continuously with 20 lb. of silage per head per day from 16th July, when a small silo was filled with oat and tare silage, until 3rd August, when fermentation was quite complete and the heat had passed off, without suffering any ill-effects and appeared to thrive upon it. Such quick feeding, of course, requires further trial before general adoption, but in any case silage can be safely fed within 10 days of making. On the other hand silage can be kept indefinitely without suffering loss of food value, and several cases have been recorded of its being kept in tower silos for 3 and even 5 years without deterioration, beyond the moulding of any part exposed to the air.

(2) Silage, when once it is made in the tower silo, is ready to feed without any other preparation than being thrown out of the silo and put into the mangers. The labour of feeding as compared with root feeding is much reduced, and in practice one man can attend to double the head of stock fed largely upon silage as compared with others fed upon a heavy root ration.

(3) Stock fed upon silage generally present a healthier appearance with more bloom on their coats than when fed upon other foods. An interesting incident in this connection occurred in the feeding experiments of 1921-22 when for purposes of keeping account of the cost of the experiment an independent valuer was called upon to value the two lots of cattle at the beginning and end of the experiment. The first valuation of the cattle was made on 15th December, 3 weeks after they had been placed on the experimental rations. The weights of the cattle were then almost identical and the valuer, probably deceived by the appearance of the coats, valued Lot I on silage at £13 per head and Lot II on hay at £11 15s. At the end of the experiment and after the rations had been changed over, the same valuer estimated the value of Lot I, now upon hay, at £18 and Lot II, now upon silage, and weighing only 14 lb. per head more than Lot I, at £19 2s. 6d. In other words on two occasions, at the beginning and end of the feeding period, when the two lots were almost identical in live weight, those fed on silage were

worth 25s. and 22s. 6d. per head more than those fed on hay. This case, though illustrative of the influence of silage upon the coats of stock fed upon it is extreme, and the writer does not wish to infer that silage had been responsible for such real differences in value as the figures express.

(4) Well-made silage is particularly good food for weaning calves, because being soft and succulent it is easily masticated and digested, and calves generally are less likely to become pot-bellied when this forms a considerable part of the ration.

(5) Silage is particularly valuable to the dairy farmer because of the reliability of the crop. The yield of mangolds both on very light and on very heavy land in the Eastern Counties is proverbially uncertain. Silage, though it will not produce the same quantity of food per acre as a good crop of roots, is much more reliable and therefore more satisfactory for the dairy farmer upon these soils.

(6) Cattle fed during winter upon silage are generally found to go ahead better when turned out to grass in spring than those fed largely upon roots.

(7) Silage is a good food for sheep. It may be fed in moderation, up to 14 lb. per day, to horses, but on account of its fibrous nature should not be fed in quantity to pigs.

* * * * * *

LAND DRAINAGE AND THE RIVER ROTHER: THE POSITION AT RYE HARBOUR.

IN this *Journal* for May, 1923, p. 113, there appeared an article headed "Land Reclamation: Some aspects of land reclamation with particular reference to the alleviation of unemployment." In that article certain examples were given to show how the cost of maintaining coast defences, especially in front of artificially reclaimed land, was crippling agricultural land in certain parts of the country; and among these examples was included the case of the river Rother (Sussex), the mouth of which for many years has been silting up owing to the littoral drift of shingle which has tended to block the mouth of the river. When the above article appeared the prospect was extremely gloomy, and it looked as if, in the absence of any remedial measures, the position would become increasingly difficult and that the mouth of the river would ultimately become so completely blocked that a vast fresh water lake would spread itself all over the marshlands drained by it.

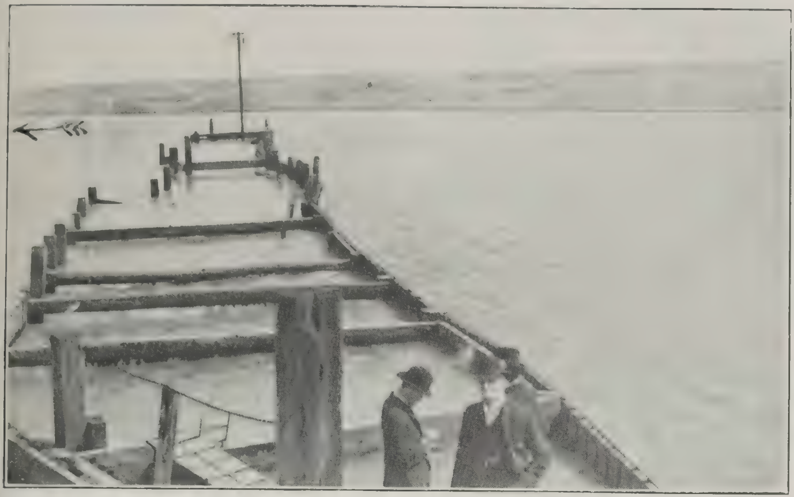

Fig. 1.—August 1924, showing obstructing Shingle Spit and End of Eastern Pier. Looking seawards.

Fig. 2.—Rye Harbour 20th January 1925.

Fig. 3.—Rye Harbour, 19th March, 1925.

Fig. 4.—23rd August, 1924. The Shingle Spit. View from head of Western Training Groyne, looking East. The Eastern Pier extension would meet the spit where group is standing.

Fig. 5.—21st February, 1925. Showing break through Shingle Spit and extended Eastern Pier. Taken from new Western Groyne which contributed materially to the "Break through."

Those who are interested in the subject, and more especially those who are affected by the trend of events in this locality, will probably be glad to know that, by means of funds voted by Parliament for the relief of unemployment, the Ministry has been able to finance liberally certain works at the mouth of the river, which have been so far successful in achieving their object, namely, to create a straight run out for the river to the sea.

It is necessary to explain that the littoral drift of shingle in this locality is from west to east, consequently the river Rother was forced by a solid bank of shingle accumulating at its mouth to deflect its course at right angles from west to east for a certain distance and then to find its way out to sea as best it could round the edge of the accumulated shingle bank. The works that have been carried out by the Rother Levels Commissioners, with financial assistance from the State, include the construction of groynes on the right bank of the river mouth, which have had the effect of arresting the drift of further shingle. Simultaneously the eastern pier was extended with timber sheet piling so as to close the eastward run of the river and enable the ebbing waters to impinge upon and wear down the shingle spit on the river face.

The net result of both western and eastern works was to erode to a knife edge the shingle spit, through which the river was finally forced (in spite of a succession of gales which, by accumulating material, rendered the position at one time almost hopeless), by the closure of the eastward run, assisted in some measure by hand excavation of the shingle.

The position will be made clearer by the accompanying photographs. Figs. 1 and 4 show the state of the river mouth in August, 1924; Figs. 2, 3 and 5 show the development of the scheme, which has resulted in the river having a direct run to sea since 20th February, 1925.

It must not, however, be thought that these works are in any way final. In order to stabilise the position, it will be necessary to construct further western works in support of those already constructed, and all these works will have to be continued seawards as and when the shingle shows a tendency again to creep round the seaward end. Further, it will be necessary to deepen the river Rother throughout its tidal length where the accumulated matter has increased enormously in recent years and prevents the full benefit of the works at the river mouth accruing to the waterlogged lands of the valley.

These further works will, the Ministry hopes, be taken in hand and it is satisfactory now to record that what has been done has already acted as an incentive to the riparian owners to combine and take some action for securing the improvement and maintenance of this important drainage outfall.

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THE BEAN APHIS.

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THE Bean Aphis (*Aphis rumicis*, Linn.) which infests broad bean plants in early summer, is well known to the gardener and allotment holder, owing to the familiar black masses of these insects which are often found in dense colonies on the upper part of the stem and below the leaves. The insects are frequently referred to as "black fly," "black dolphin" or "blight." On the continent, this aphid is a serious pest of sugar beet, especially those varieties which are grown for seed. The insect has a wide distribution, and its occurrence in any particular season is largely affected by the prevailing weather, moderately high temperatures being especially favourable for its rapid increase in numbers. Although the broad bean is specially infested by this insect, it can live on a wide range of plants. Field beans frequently suffer heavy attacks and mangolds and red beet may also be attacked, but to a less extent. Certain common weeds such as docks (*Rumex*), poppies (*Papaver*), shepherd's purse (*Capsella bursa-pastoris*) and fat hen (*Chenopodium album*) are favoured summer food-plants, while the spindle tree (*Euonymus europæus*) is its known winter host, on which the fertilized eggs are laid in the autumn.

The following account of the life history and biology is based on a detailed study of this insect carried out at Rothamsted Experimental Station.

The Life History.—During its life cycle, the bean aphis appears under different forms which are represented in Fig. 1. Fertilized eggs (Fig. 1A) are laid on the branches of the spindle tree in October, near the base of the leaf buds or in crevices of the older branches, by the sexual females (Fig. 1F). The eggs hatch out in the following April, when the spindle tree is bursting into leaf. The young aphides feed on the buds and develop into the so-called "stem-mothers," or fundatrices (Fig. 1B). These wingless individuals became adult in about three weeks, depending on weather conditions, and then pro-

duce living young, which commence to feed on the buds almost immediately after they are born.* These young (first generation) generally develop into wingless females (Fig. 1C), but occasionally a few winged forms may be produced (Fig. 1D). After about a fortnight the first generation females become adult and produce living young of the second generation, the majority of which develop into winged forms (Fig. 1D). These are the spring migrants which migrate to the summer food plants. By early June, owing to the production of winged forms, most of the aphides have left the spindle tree, but small colonies may be found on cultivated *Euonymus* throughout the summer.

When the migrants alight on suitable food-plants, they produce living young which develop into wingless individuals, which in turn also produce living young. A large colony of aphides is therefore soon formed on an infected plant. Eventually winged forms (summer migrants) appear in these colonies and fly to other food plants, either of the same kind or of totally different species. Reproduction goes on in this way throughout the summer, resulting in several summer generations and a wide distribution of the insect. Temperature conditions considerably affect the rate of development and reproduction of the insects, but generally speaking in a favourable season, each aphid is capable of producing on an average about five young daily, with a total number of 40-50 young. The young may reach maturity after about 8 days, so that the numbers of aphides which may be produced in a season is enormous.

In September winged males (Fig. 1E) are produced in the colonies on the summer host-plants and the winged females which appear at the same time, although resembling the winged individuals of previous generations, are physiologically different, in that the young aphides they produce develop into true sexual, egg-laying females (Fig. 1F). These winged forms are the re-migrants. They fly back to the winter host (spindle tree) in late September and early October, and produce there the small, wingless sexual females (Fig. 1F). The males fly over to the winter host, pair with the sexual females, and fertilized eggs are eventually laid by the latter on the spindle tree.

* This phenomenon whereby the females of certain generations are able to reproduce without mating with a male, is the rule amongst aphides and is known as parthenogenesis. The production of living young, in contrast to the production of eggs, is also a common feature, the females being spoken of as viviparous females. It is a phenomenon which allows of the greatest number of aphides being produced, and is evidently an adaptation which ensures the widest distribution of these insects during the favourable seasons of the year.

Owing to the food plants dying down and bad weather conditions, the aphides remaining on the summer hosts die, but colonies may be frequently found until late in the autumn, and on suitable plants in sheltered situations, may carry on parthenogenetic reproduction throughout the winter. The writer has found colonies in December and January on the common shrub *Euonymus japonicus* in the south of England, and on small *Euonymus* bushes under frames near London throughout winter. Sexual forms may also be produced on plants other than the spindle tree, eggs having been found laid on docks and scarlet runner beans, but naturally a woody shrub like *Euonymus* is best suited as a winter host.

The Different Forms of the Bean Aphis.—During its life history the bean aphis assumes different forms, which are indicated in Fig. 1. These can be distinguished with the aid of a hand lens, but the reader is referred to the detailed description of the various forms given by the writer in Bulletin of Entomological Research, Vol. XII, pp. 81-89.

The general appearance of the insect is black, but the size and colour vary somewhat according to the food plant on which it is feeding. The various forms are as follows:—

(a) *The Stem Mothers*, Fig. 1B, which hatch from the fertilized eggs and are found at the end of April or in early May on the spindle tree, where they cause curling of the leaves of the young shoots. They produce living young, which form dense colonies on the plant.

(b) *Winged Females*, Fig. 1D, which are found on the spindle tree in May and later in the season on different food plants, to which they have migrated. They produce living young and further winged forms appear in the colonies from time to time during the summer, on various food plants.

(c) *Wingless Females*, Fig. 1C, which are found in May on the spindle tree and from May to October and often later in the season, on the summer food plants. They produce living young.

(d) *Winged Males*, Fig. 1E, which appear at the end of September and in early October on the summer food plants and fly to the winter host-plant (*Euonymus*).

(e) *Egg-laying Females*, Fig. 1F, which are found on the spindle tree in October, where they lay fertilized eggs which hatch out in spring.

(f) *Eggs*. Fig. 1A, which are laid on the spindle tree and hatch out in the following May; they are black.

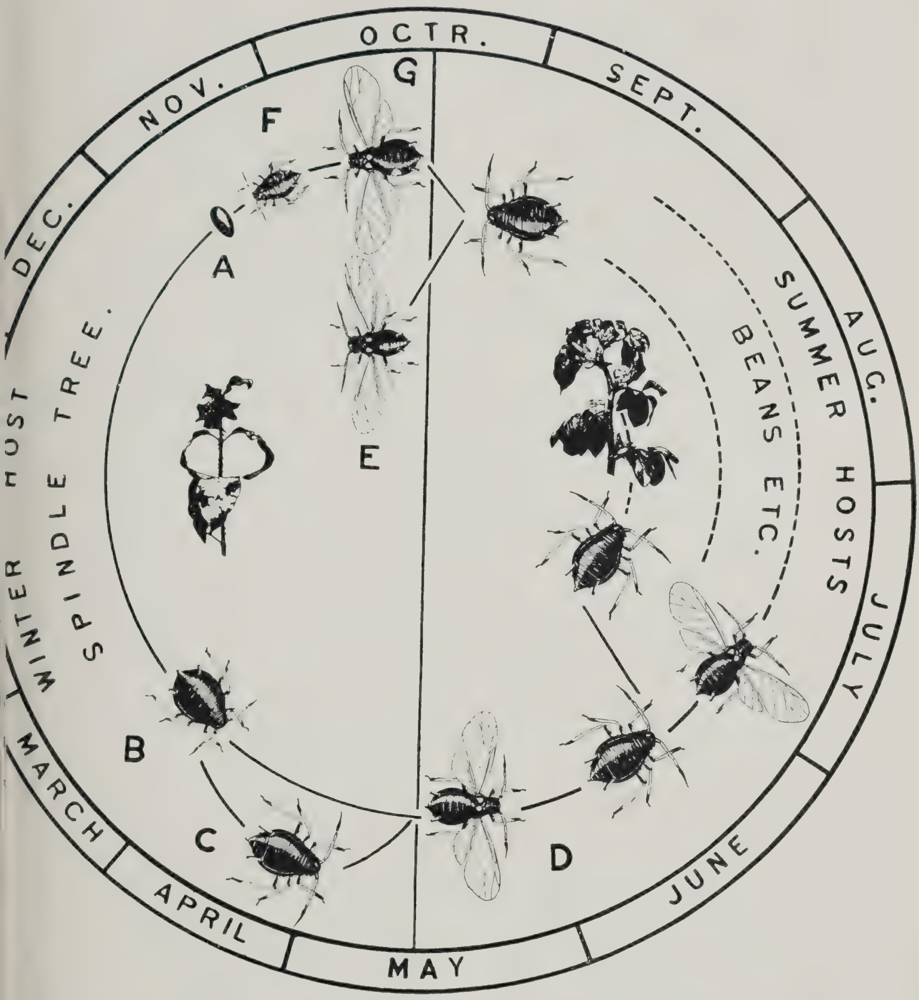


FIG. 1.—Diagram illustrating the life-cycle of the bean aphis (*Aphis rumicis*) and showing the different forms the insect passes through. The period spent on the winter host is represented on the left half of the circle; that on the summer hosts on the right half. The sectors of the circle indicate the months and the concentric dotted lines a varying number of summer generations. A. egg, B. fundatrix or stem mother, C. wingless viviparous female, D. winged viviparous female (migrant), E. male, F. sexual egg-laying female, G. autumn remigrants which produce the sexual females. The figures of the aphids are from original drawings.

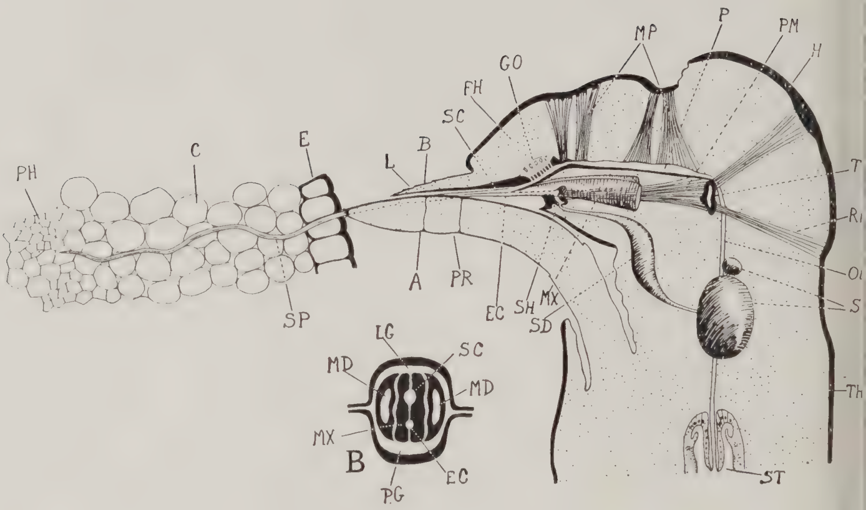


FIG. 2.—This is a drawing (much enlarged) showing the inside of the head and fore part of the body of the bean aphis, as seen in side view. The insect is in the act of sucking sap from a bean stem, the latter being cut across so as to show its cellular structure. The piercing mouth parts of the aphid *SP*. can be seen penetrating into the stem. Fig. B. shows the arrangement of the mouth parts in section when cut through at *AB*. The piercing organ *SP*. is seen lying supported in a groove *PG*. in the proboscis *PR*.

The relationship of the different parts will be understood by reference to the explanatory letters. *C*., *E*. and *PH*., cells of various parts of the bean stem. Saliva from the glands *SG*. passes along the tube *SD*. into the chamber *SH*., and from thence is pumped down the piercing organ in the tube-like canal *EC*. into the plant tissues. *FH*. and *H*., parts of the head of the aphis. The plant sap is sucked up the small channel *SC*. into the food chamber *P*., and passed through the tube or œsophagus *OE*. into the stomach *ST*. The sap is tested by the taste organ *GO*., before passing into the food chamber (*Pharynx*). *L*., *LG*., *MD*. and *MX*. are various structures composing the mouth parts of the insect. *MP*., *PM*. and *RF*. are muscles which act on the different structures of the head and mouth parts during feeding. Strong supporting bars *T*. are present in the head, which support its various structures. *TH*. is the part of the body which joins on to the head.

Biology of the Bean Aphis.—It is seen from the remarks on the life history, that it is the rapid increase of the aphis in the parthenogenetic summer generations which results in the serious infestation of plants.

The insect feeds on the juices of the plant, the mouth parts being specially adapted for sucking out the sap from the plant tissues. The parts of the mouth which form the cutting mandibles and maxillæ in biting insects, are developed in aphides to form long, delicate, chitinous needles or stylets, which lie close together along a deep groove in the proboscis and form an efficient piercing organ, which is inserted into the plant tissues. The method of piercing the plant tissues is shown in Fig. 2. The two inner stylets lie closely apposed throughout their length and two canals are thus formed between them, as will be seen in the cross section (Fig. 2B). Along the upper or dorsal canal (S.C.) the food is drawn up into the pharynx (P) and from there passed backwards along the oesophagus (OE) into the stomach (ST). Along the lower or ventral canal (EC), secretion from the salivary glands (S.G.) is forced into the plant tissues while the insect is feeding. This salivary secretion is able to partially digest the sap, by changing starch into sugar. It also destroys parts of the walls of the cells thus facilitating the penetration of the piercing organ. The latter penetrates into the phloem region of the vascular bundles, which tissue affords the richest food (sap) for the insect.

The damage to the plant is caused by the tearing of the tissues by the piercing organ, by the destructive action of the saliva on the plant cells and by the weakening of the plant by the continual withdrawal of sap from its tissues.

At frequent intervals during feeding, the aphides excrete large drops of waste products. This substance is the so-called honey dew, which forms a sticky layer on the stem and leaves of the plants and the excretion from some species of aphides is particularly sought after by ants. It consists of the waste products of metabolism, and the undigested contents of the plant juices. In the case of some species of aphides, this excretion affords a suitable medium for the growth of moulds, which form a black deposit on parts of the plant, thereby affecting its powers of assimilation.

The degree to which plants are liable to infestation by *Aphis rumicis* may be affected by various factors, which are best discussed separately.

(a) *Influence of Climatic Factors on Infestation.*—The progress of infestation is considerably affected by temperature, owing to the fact that, in favourable warm weather conditions, the aphides reach maturity more quickly and produce more young daily, whereas in cold weather the reverse is the case. With a mean temperature of about 70° F., the aphides reach maturity in about 8 days, whereas with a mean temperature of about 55°F. the development may take as long as 18 days. Counts made of the number of aphides present on an unmanured bean plant, after 14 days' reproduction, commencing with one adult wingless female, showed that on an average (average of five plants) 1,340 aphides were produced when the mean temperature of the period was 71°F., whereas an average of only 460 was obtained for a reproduction period of 18 days, when the mean temperature of the period was 58°F. It is evident that the relation between the best temperature for the growth of the plant and that for the development of the aphid is an important consideration with reference to the infestation of cultivated plants by these insects. Aphides invariably attack young growing parts of the plant and, with slow progress of the infestation, the young growth would more readily overcome the effects of the attack. The climatic conditions during the 1924 season were not favourable for the rapid increase of aphides, and outbreaks of the bean aphis were small. Further, it was observed that young aphides which hatched from eggs during warm weather in April, were killed before they reached maturity by subsequent cold weather. This also reduced the chances of widespread infestation. Aphides are fragile insects and bad weather conditions generally, such as heavy rain and wind, result in many of them being destroyed.

(b) *Influence of Different Food-plants on Infestation.*—Although the bean aphis lives on a wide range of plants, it does not flourish equally well on all of them. Since its food is the plant sap, the suitability of the sap of different kinds of plants is a factor which affects the progress of the infestation. The following figures show the relative degree to which some of its food plants are liable to infestation. The figures represent the average number of aphides (average of five plants) produced on one plant during 14 days' reproduction, commencing with one adult wingless, viviparous female. The reproduction period for all the plants was taken during the same days, so that climatic factors were the same for all the plants. It will be seen that beans suffer the heaviest infestation :—

Plant.	*Longpod beans.*	*Sugar beet.*	*Red beet.*	*Mangolds.*	*Shirley poppies.*
Number of aphides produced.	896	123	115	114	164

(c) *Influence of Different Varieties of Beans.*—Different varieties of broad beans also vary in the degree to which they are liable to infestation, but the differences are small and unimportant, probably owing to the fact that the varieties are so closely related. The infestation figures obtained for a 14-day reproduction period, on four varieties, estimated as described in the preceding paragraph, are given below :—

Variety of bean.	*Longpod.*	*Windsor.*	*Mazagan.*	*Dwarf.*
Average number of aphides produced.	896	828	1,100	746

Several varieties of field beans were also tested and these showed rather greater variation in susceptibility to infestation. It was possible to group the varieties into classes, each class representing a different grade of susceptibility. Longpod broad beans were taken as the control, their susceptibility being taken as 100 per cent., and figures obtained for the other varieties were referred to this standard. Some of these varieties are given below, together with the degree of susceptibility of the groups to which they belong.

Class.	*Degree of susceptibility.*	*Varieties in the class.*
Control	taken as 100 per cent.	Longpod.
A	98	Bohus bean (Sweden). Mazagan.
B	55	Heligoland. Granton (Scotch var.)
C	39	Spring tick (Suffolk). Winter beans. Small tick. Carse. Kilbride.
D	3	*Vicia narbonensis.*

The high degree of resistance (97 per cent.) of *Vicia narbonensis* is interesting, as this is a wild type of bean, found in certain parts of the eastern Mediterranean area, and is considered by some authorities as the prototype of the cultivated bean (*Vicia faba*).

(d) *Influence of Age of Plant on Infestation.*—It is well known that aphides favour the young growing parts of plants and it was found by experiment that bean plants of one series, which were six weeks older than the plants in another series, when infected with the bean aphis in June, gave an intensity of infestation which was about 50 per cent. less than on the younger plants. This indicates the value of early sowing of beans where possible,

so that the plants may be well advanced before the winged aphides are about.

(e) *Influence of Soil Conditions and Manurial Treatment on Infestation.*—Soil condition is a factor affecting the growth of the plant, and the aim of manurial treatment of the soil is to improve the quantity and quality of the crop. In this way changes produced in the juices of the plant influence the development and reproduction of the aphides feeding on them. Field observations indicate that the condition of the soil has an influence on infestation, but conclusive experimental evidence on this question is not yet available. It is interesting to note, however, that the intensity of infestation on beans grown in sand watered with normal food solution, was found to be greater than on beans grown in unmanured soil watered with the same solution.

The progress of infestation on beans grown in unmanured soil was found to be slower than on bean plants which received complete artificial manures. The relative intensity of infestation on bean plants grown under different treatment, estimated as explained above, is shown below.

Treatment of Plants. (Longpod broad beans.)	*Intensity of Infestation.* per cent.
Grown in sand, unmanured, watered with tap water only.	Control taken as 100.
Grown in sand, watered with complete food solution.	225
Grown in soil, unmanured.	140
Grown in soil, manured with complete artificial manures.	200

Further experiments with beans grown in sand showed that absence of potash in the culture solution with which the plants were watered resulted in a decreased infestation, whereas with increased potash and phosphates a heavier infestation was obtained. These preliminary results afford sufficient evidence that the relation between soil conditions and the manurial treatment of plants and aphis infestation, is worthy of further investigation.

Control Measures.—We have seen that weather conditions play an important part in favouring or restricting the progress of aphis infestation. In addition, the bean aphis is to some extent controlled by Ichneumon parasites and their allies, which lay their eggs inside the bodies of the aphides. The grubs, which hatch out from these eggs, feed within the aphides, thereby killing them.

(a) *The Farm.*—Owing to the rapid progress of aphis infestation during favourable weather it is difficult satisfactorily to deal

with an infestation on a field scale once it has become well established. Good cultivation and manuring which produce strong, healthy plants, will enable the plants to recover more readily from a temporary outbreak. Certain types of field beans, referred to in a previous paragraph, which are less susceptible to infestation, might be grown where suitable.

Early sowing is desirable, as in this way the plants are well advanced before the winged aphids are about and the chances of heavy infestation are less.

In the early stages of an attack (May), a few heavily infested bean plants may be noticed in the crop, and if these are cut down it will obviously reduce the chances of a wider infestation.

Since *Aphis rumicis* has many food plants amongst so-called weeds, such as shepherd's purse, fat hen, docks and poppies, their presence assists the spread of an infestation. Beans are frequently heavily attacked, and it is inadvisable to grow other susceptible crops such as sugar beet and mangolds near to a crop of beans, owing to the possibility of migration from the beans to the other crop.

It may be thought that by the eradication of the spindle tree the pest could be controlled. In fact destruction of *Euonymus* has been advocated in certain parts of France, as a method of control of this aphis on sugar beet. This, however, would not, I believe, have the desired result in England. The wild spindle tree is locally distributed and not very common, and although it has been proved to be a winter host of *Aphis rumicis*, the insect can winter in other ways. Colonies have been found on mangolds growing in a rubbish heap and eggs have been found laid on the leaves of sugar beet in France in October. Under experimental conditions the writer has found eggs laid on beans in October. A very important consideration, however, is the fact that the aphis can carry on parthenogenetic reproduction throughout the winter in warm sheltered situations. The writer has carried on continuous parthenogenetic generations of this species for four years on beans. Living colonies have been found in winter on the common evergreen shrub *Euonymus japonicus* in the South of England, which increased enormously in numbers in the warm days of early spring. With warm conditions a rapid increase of the winter colonies and the production of winged forms would soon result in a wide district being infected.

(b) *The Garden and Allotment.*—The gardener has an easier task in controlling the infestation on broad beans than is the case with the field bean crop, but the remarks in the previous

paragraph also apply to the garden crop. Rhubarb which is running to seed and asparagus should be watched for colonies of the bean aphis in early summer. *Euonymus japonicus* is a common garden evergreen shrub on which the aphid feeds, and in sheltered situations, especially where pot plants of this shrub are kept under frames in the winter, colonies of the insect may be found throughout the winter, thus affording a source of infection the following spring. Plants which are kept under frames or in greenhouses during winter should be watched for any signs of the bean aphis. Another species of aphid, *Myzus persicæ*, is frequently found on greenhouse plants in winter.

In the early stages of attack the young growing tips of the bean plants should be removed, as the aphid colonies invariably start at the growing apex of the plant, and this procedure reduces the progress of the infestation.

Where necessary the plants should be sprayed with a contact insecticide, the best type being one containing nicotine. Formulæ of suitable insecticides, together with instructions for spraying, will be found in the Ministry's leaflet No. 37.

* * * * * *

APPLE PACKING.*

J. STODDART, J. TURNBULL and A. WHITING,
Ministry of Agriculture and Fisheries.

FROM the correspondence which has recently appeared in the technical press it would seem that the principles of fruit packing, particularly in regard to the boxing of apples, are not so clearly understood as they might be. The methods employed in box packing were dealt with in a previous article,† and we shall now explain some of the principles underlying those methods. In the disposal of apples there are many factors which are interdependent, and because of this the subject is treated more widely than may appear necessary.

Grading.—In general, grading means the removing from a bulk of fruit of all specimens which are below normal size, blemished, damaged, malformed or not typical of the variety. In the case of apples further separation is made in regard to size and colour, and attempts are being made to fix a standard of grades for apples.

That the grading of fruit is profitable to the producer is accepted by all who practice it, and such acceptance must be taken as proof by those who do not grade their fruit. In

*This article should be read in conjunction with the Ministry's Leaflet No. 98.

† This *Journal*, Sept., 1921, page 531.

attempting to prove the value of grading, isolated consignments are misleading. Even the results of a number of trials of equal lots of graded and ungraded fruit do not indicate the position accurately, because the grower who changes over has to live down his reputation for marketing ungraded fruit, and at the same time build up a reputation for honest grading before he can expect to reap the benefit.

Marketing.—The grower who markets ungraded fruit must not think that the prospective buyer is to be misled into paying the same price for "culls" as for graded fruit. The buyer who purchases large quantities of fruit has no time to spare for detailed examination and will only look at consignments which are well known to be honestly graded and packed. Some other buyers will buy ungraded packs, *but only after careful examination*, and the price offered is generally based on the estimated amount of good fruit present. In these cases the estimated value is rarely very profitable to the grower, and the general result is that the "culls" realise nothing, although the grower has paid freight, package, tolls and other charges on them. In times of glut ungraded packs are slaughtered.

The sizing of fruit varies in importance according to the kind, but with apples sizing is of the greatest importance. The separation of graded apples into uniform sizes invariably results in an improvement in the price realised for the bulk, no matter what type of package is used.

Packages.—There are two classes of packages for apples, viz., returnable and non-returnable. These are further divided in accordance with the purpose for which they are used: (1) for distant markets, and (2) for local markets where no second transit is incurred.

Returnable—Distant market.—The main considerations for packages for this purpose are durability, protection of contents, weight, cost and their utility as containers for various fruits and vegetables. In the past, many types of containers have been used, but those found to be uneconomic have been almost eliminated, while the round wicker bushel, half-bushel and strike have become almost standard packages. For cooking-apples, the half-barrel (or grape barrel) is largely used, particularly in the Midlands and the North, and is a satisfactory package. The "Pot," although generally condemned for fruit, is still used on a small scale in the Midlands.

Returnable—Local Market.—Where produce is sold locally various kinds of established types of packages are used, including

once-used non-returnables, which are purchased from retailers at a reduced price. In some districts special types of strong bushel and half-bushel boxes are used, but these have no definite standard; they are used for all kinds of market garden produce, and their uniformity and rigidity allows the safe stacking of high loads. These boxes are quite satisfactory for the local disposal of apples by weight.

Non-returnable—Distant Market.—For distant markets the non-returnable package is essential. Besides clearing away the worries and cost of returning, it increases the speed of distribution, extends the area of disposal, and finds universal favour with the retailer.

The requirements of a package for dessert apples does not always coincide with those required for cooking apples, but experience proves that the Standard Box (described in detail later) is the most suitable package for the *best grades* of dessert varieties, and quite satisfactory for some cooking varieties. It ensures the safety of the contents during long transit and much handling. Various types of chip packages are in use but, as yet, these have not fully established themselves as apple packages.

It is by no means certain that finality in design in the standard box has been reached, and it is possible that a different and better type of package may be produced. For the present, however, its supremacy for high-class, graded dessert apples is unquestionable.

The following points must be considered when evolving new types of packages for apples :—

Cost.—This is of the greatest importance when all other points are equal.

Shape.—Rectangular packages require to be approximately square on the transverse section in order that the diagonal pack may be used.

Durability.—This must be sufficient to give adequate protection to the contents in normal conditions of transit and handling.

Weight.—Transport charges make the weight of packages a matter of considerable importance.

Stacking.—A successful package must bear stacking to a considerable height without damage to contents.

Although the standard bushel box is suitable for bulk disposal of dessert apples, there is undoubtedly also a need for a smaller package which can be sold intact to the consumer, and some development in this direction is desirable. As regards packages

for cooking apples, a few growers have used the standard box for some years with satisfactory results, but experience is limited, and it is not yet possible to gauge the extent of the demand for this package. Search for a more suitable package is being made.

To a small extent, half-barrels are used as non-returnables, but they are usually too costly for the purpose.

Non-Returnable—Local Market.—For produce sold locally new non-returnables are being increasingly used for soft fruits, because such packages can be sold to the consumer intact. The sale of intact packages of apples has not yet developed to any extent, but considerable scope is offered if a suitable package can be produced. For local trade it is possible that a comparatively frail package would serve the purpose.

Standard Apple Box.—The internal dimensions of the rectangular bushel box adopted in Great Britain as standard are 18 in. long, $11\frac{1}{2}$ in. wide, and $10\frac{1}{2}$ in. deep. The ends and sides are rigid, but the top and bottom boards bend under pressure.

This box appears to have originated in Oregon and has replaced the American and Canadian standard package of 20 in. by 11 in. by 10 in. It is probable that the development of the "Diagonal" pack (described later) was the cause of the change-over, but the main reason is that the standard 18 in. box will take a longer range of 3—2 packs than the older 20 in. box.

The previous statement that a box to take the diagonal pack should be square in transverse section appears to be contradictory in view of the dimensions given above. This is explained by the fact that when the standard box is filled, the depth at the centre is 12 in. to $12\frac{1}{2}$ in. and at the ends $10\frac{3}{4}$ in., the average depth being approximately $11\frac{1}{2}$ in., so that the filled box is nearly square in transverse section. If no "bulge" were used the box would need to be $11\frac{1}{2}$ in. by $11\frac{1}{2}$ in. by 18 in.

The sizes and thicknesses of the wood for the standard box for use in Great Britain are as follows:—

Ends	2 pieces	$11\frac{1}{2}$ in. long	$10\frac{1}{2}$ in. wide	$\frac{3}{4}$ in thick.
Sides	4 ,,	$19\frac{1}{2}$,, ,,	5 ,, ,,	$\frac{5}{16}$,, ,,
Top and bottom	4 ,,	$19\frac{1}{2}$,, ,,	5 ,, ,,	$\frac{3}{16}$,, ,,
Cleats	4 ,,	11 ,, ,,	$\frac{3}{4}$,, ,,	$\frac{1}{4}$,, ,,

All boards must be sound and free from knotholes and cracks.

The end pieces may be made of battens and a thin board instead of one piece, provided the dimensions are the same. For export it is advisable to make the sides $\frac{3}{8}$ in. thick and the top and bottom boards $\frac{1}{4}$ in. thick.

The object of making the top and the bottom boards thin is to enable them to bend when the box is being nailed down. The

bending of these boards produces a bulge which tightens the pack; this is essential for safe transit and handling.

The "Bulge."—The curved top and bottom on a box of press-packed apples are known as the "bulge." The object of this bulge is to keep the pack tight and firm, without bruising the fruit. Apples will support considerable pressure, if evenly applied, without bruising. Pressure from a sharp edge, however, will cause bruises, but bruising is more frequently caused by the jolting of apples which have been too loosely packed in the box.

When the top boards are nailed, the apples are pressed down and the bottom boards bend equally with the top. These boards act as a spring and provide the pressure to keep the apples from jolting. This pressure is necessary because apples cannot be packed tightly enough by hand, and it also compensates for shrinkage in transit and storage. The "Diagonal" pack, (explained later) causes the pressure to be distributed evenly throughout the box. In a well packed box with $1\frac{1}{2}$ in. bulge there is no risk of damage to the contents. Although continued pressure may produce slight flats on some apples when imperfectly packed, it does not set up the rot which follows a sharp blow.

With the most efficient sizing apparatus there still remains a variation in size, and advantage is taken of this by selecting the apples as they are placed in the box, to produce the required bulge. The slightly smaller apples are placed at the ends and graduated in size towards the middle of each layer in the box (see Fig. 4). By this means the apples in a filled box project from $\frac{1}{4}$ in. at the ends to 1—$1\frac{1}{2}$ in. in the middle.

As the variation in transverse diameter between apple and apple may not exceed $\frac{1}{16}$ in., it would appear that selecting for packing would be a tedious and lengthy process, but a few hours' practice enables the average packer to select, wrap and place apples with speed and accuracy. A packer of moderate experience can select, wrap and pack 200 apples in 10 minutes. As the necessity for the bulge in the standard box has been a matter for discussion, it was decided to send a consignment of boxes (approximately the same size as the standard box) without a bulge, together with some standard boxes with the bulge, from various parts of the country to London. On arrival the contents of the boxes were examined and the better condition of the fruit in the standard boxes proved conclusively that the bulge is necessary.

The bulge has the additional advantage that, when the box is opened, the spring of the bottom raises the apples slightly, and gives the box a full appearance, while the box without a bulge appears to be insufficiently filled.

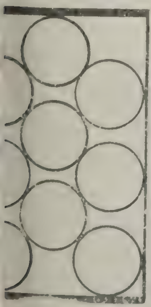
Diagonal Pack.—When the 20 in. box was first used, the first layer only was " faced " and the remainder of the apples " filled in," just as headed barrels are filled to-day. Then packing in straight rows began, but difficulty arose in getting the apples to the right height. To rectify this some apples were turned one way and some another, and there was a different method for every size of every variety. The present 18 in. box was eventually introduced, and for a time both boxes were used. Later it was found that any size or shape of apple could be packed to the correct height in the 18 in. box by placing the apples on the side in diagonal instead of straight rows. This system so simplified box packing that unskilled workers could obtain good packs, and its introduction has undoubtedly accelerated the use of boxes for apples. The main advantages of the diagonal pack are :—

(1) All sizes of apples can be packed on the cheek in the standard box, so that they fill the box to the required height.

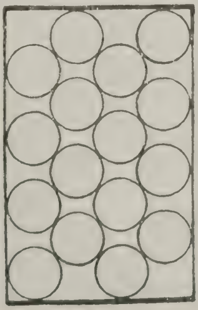
(2) The pressure of the top and bottom boards is evenly distributed over the greatest possible area of fruit surface.

(3) An orderly pack is a visible guarantee of uniformity in size.

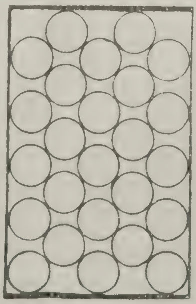
The diagonal pack automatically provides for a primary division of sizes into groups, which are indicated by the number of apples in each of the first two rows across the box; thus, 2—1, 2—2, 3—2 and 3—3, the first figure indicating the number of apples in the first transverse row against the end, and the second figure the number in the next transverse row as shown in the following diagrams.



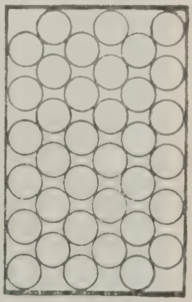
1st layer
—1 × 3—3)



1st layer
(2—2 × 4—4)



1st layer
(3—2 × 5—5)



1st layer
(3—3 × 6—6)

The limiting factor in each group is the number of apples of equal diameter which will lie touching along the diagonal of the box end and project $\frac{1}{2}$ in. above the top. Thus the largest size for 2—2 pack gives 4 apples diagonally across the end, 3—2 gives 5 and 3—3 gives 6. This can be seen so far as the 3—2 group is concerned in Figs. 5 and 6. There is, however, a certain amount of overlap between groups as the smaller sizes of the larger group will pack the same packs as the larger apples of the next smaller group. The average diameter and average length of the various sizes within the groups control the number of apples in the longitudinal rows.

To demonstrate the diagonal pack clearly, the illustrations show a box with one side and one end which have been made of glass, the bottom being bent to the normal curve of the "bulge."

It will be seen that all lines of *apples which are in contact* are disposed diagonally in relation to any rectangle formed by the edges of the box. It is from this characteristic that the pack derives its name.

To indicate clearly the reason for the constant height, no matter what size of apples is packed, it is advisable to consider that the box has been filled with transverse vertical layers (*i.e.*, layers parallel with the ends) instead of horizontal layers. In Figs. 5 and 6. which show extremes of the 3—2 group, the first layer against the end contains 13 apples symmetrically placed. The large apples in Fig. 5 are almost in contact, leaving very small pockets into which the second vertical layer fits. The small apples shown in Fig. 6 are placed in exactly the same positions as those in Fig. 5. but they provide larger pockets into which the second vertical layer fits. The number of apples in the second layer is equal to the number of pockets in the first layer, viz., 12.

It is obvious that with decreasing sizes of apples, and the resulting enlargement of pockets, the proportion of the length of the box occupied by each layer decreases, while the height and breadth of the layer remain the same. This is clearly shown in Fig. 3, which contains 9, and Fig. 4, 16 vertical layers. In all counts of the 3—2 pack the number of lengthwise (or horizontal) layers is 5.

The largest size of round apple for the 3—2 pack is that which gives 8 transverse vertical layers with 100 apples to the box. Successively smaller sizes add to the number of such

Fig. 1.—Corner view of 3—2 pack, 113 apples.

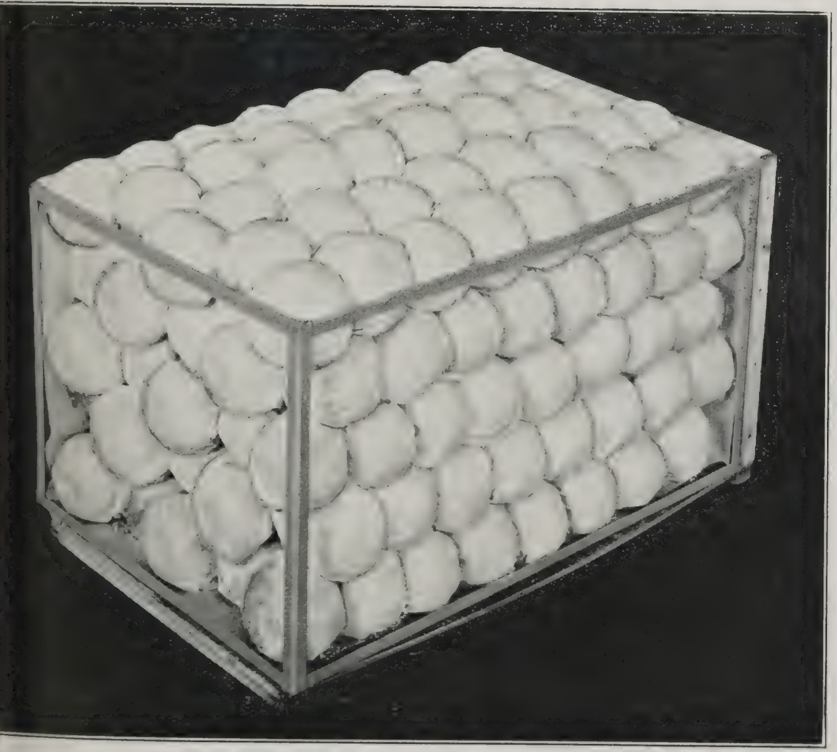


Fig. 2.—Corner view of 3—2 pack, 200 apples.

FIG. 3.—Side view of 3—2 pack. 113 apples.

FIG. 4.—Side view of 3—2 pack, 200 apples.

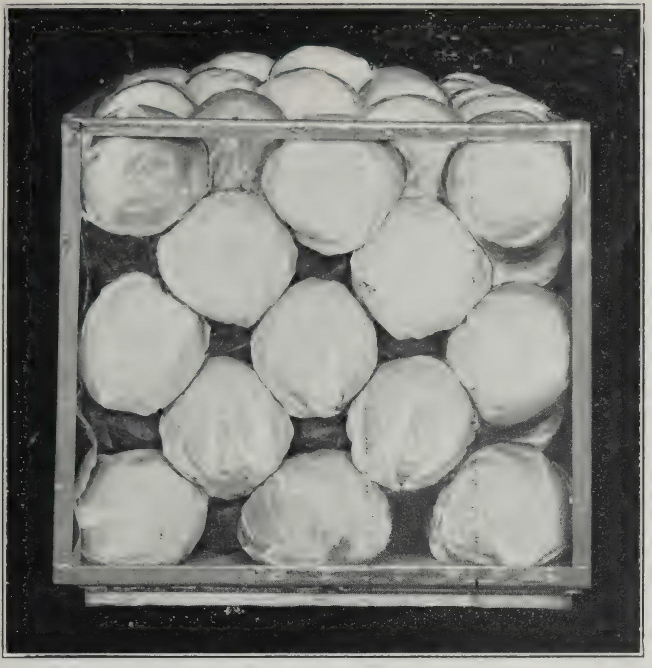


FIG. 5.—End view of 3—2 pack, 113 apples.

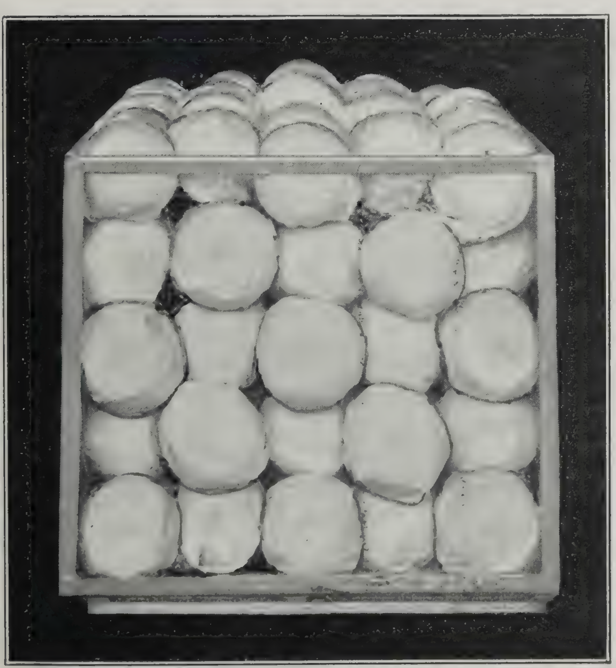


FIG. 6.—End view of 3—2 pack, 250 apples.

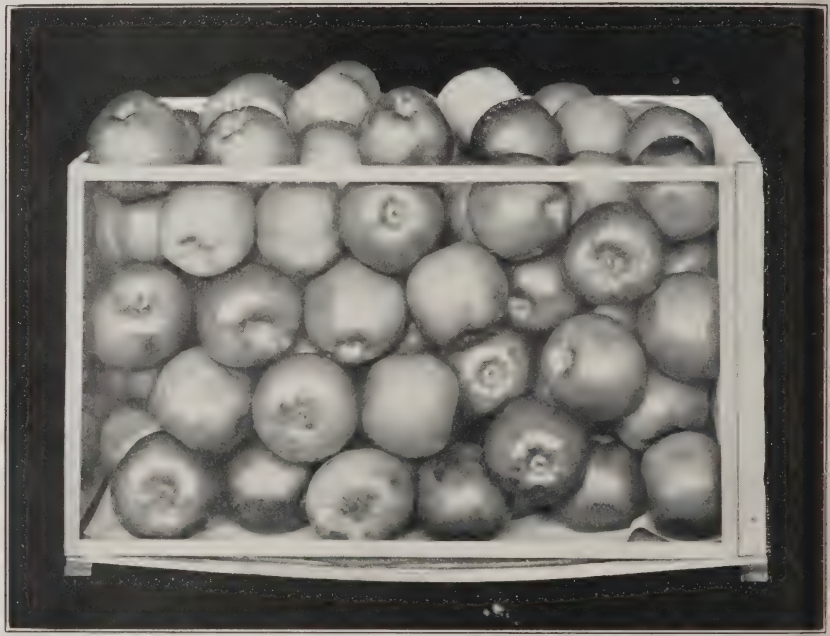


Fig. 7.—The same apples as shown in Fig. 1, unwrapped and not regularly packed.

layers, each additional layer adding 12 or 13 to the previous total. This progression is clearly indicated in the following table, which refers to the 3—2 pack only :—

								Fig. 1								Fig. 3	
al order of erse Verti- ers	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
of Apples er	13	12	13	12	13	12	13	12	13	12	13	12	13	12	13	12	13
pples in	—	—	—	—	—	—	—	100	113	125	138	150	163	175	188	200	213
of Apples ngitudinal	—	—	—	—	—	—	—	4-4	4-5	5-5	5-6	6-6	6-7	7-7	7-8	8-8	8-9

The same principles apply to the other groups. In the 2—1 there are 5 and 4 apples alternately in the transverse vertical layers. In the 2—2 there are 8, and in the 3—3 18 apples to each such layer. A full list of packs is given in the Ministry's Leaflet No. 98.

The use of the diagonal pack is of the greatest importance in the distribution of pressure. Each outside apple has 6 or 7 points of contact according to its position, and each interior apple is in contact with other apples at 8 points. When pressure is brought to bear on an outside apple it is transmitted, in part, to each of the apples with which the first is in contact, but the direction of the pressure is at an angle to that of the original movement. The second apples each again transmit the pressure received at their points of contact and so on until the pressure at each contact is equal. The movement can be observed when the top boards are pressed on a full box. This automatic distribution of pressure permits of a slight variation in the size of the apples, and adjusts inaccuracies in packing.

The diagonal pack not only gives a visible guarantee of uniformity, but it enables apples to be packed in the smallest possible space. The apples shown in Fig. 1 have been unwrapped and placed without order in the same box, Fig. 7. and in order to secure a level surface it was necessary to remove 12 per cent. of the contents.

The wrapping of the apples in paper has many advantages. It has the effect of putting a thick skin on the apple, which protects it from bruises. It also tends to prevent the spread of rot, and adds to the appearance of cleanliness. Further,

it actually takes less time to wrap and pack a box of apples than it does to pack them unwrapped. Although it is thought by some growers that box packing is difficult and costly, experience has shown that unskilled workers may be trained to pack "sized" apples correctly in two or three days, and that the wages of this work at the present time amounts to $1\frac{1}{2}$d. per bushel. There are few places where extra labour cannot be obtained in the packing season, and if the grower is already going to the expense of grading and using non-returnables, it would seem a pity to grudge the very small extra cost of packing on the diagonal system.

We are convinced that, if growers are to retain a reasonable share of the home market, no other course is possible for them but to adopt box-packing for those apples which are suitable for boxing for disposal in those markets which can handle boxed apples to advantage.

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POTATO TUBERS AND SPROUTS: THEIR VALUE IN IDENTIFYING VARIETIES.

T. P. McIntosh, B.Sc. (Agric.) Edin.

The identification of a potato variety is often a matter of extreme difficulty. During the growing season the various types are generally recognised by differences manifested in the foliage and inflorescences. Nevertheless, there are times when accurate determinations can be made only by reference to the underground parts. It has thus become necessary to consider the plant as a whole, and any aid afforded by the tuber and sprout must not be neglected. Moreover, it is desirable that all concerned should be able to place the various varieties in their tuber groups during the winter and spring months. It is proposed in the following notes, therefore, to emphasise all points which are useful in diagnosis.

Tuber.—Shortly after the potato haulm appears above ground, stolons develop in the axils of the scale leaves on the underground portion of the stem. These stolons lengthen for several internodes and ultimately swell at their tips to form tubers. The change from stolon to tuber is quite abrupt. Extensive cell division takes place in the pith, and much less in the outer cortical regions, hence the vascular tissue in passing from stolon to tuber bulges outward and is to be found not far

from the skin. Later, growth in size results from active division of cells lying between the cortex and the pith, divided into two unequal parts by the narrow vascular ring. These become the chief starch-containing cells. On cutting a mature tuber it is easy to recognise the vascular cylinder which lies, roughly, about $\frac{1}{8}$ of an inch below the skin. This cylinder encloses a large amount of storage tissue and the pith, while externally there are more storage cells as well as the cortex proper, although popularly both the latter are referred to as the cortex. In the young stolon the cortex occupies a large area compared with the organ as a whole, but in the later development of the tuber the cortex adds little new tissue and hardly more than doubles the number of rows of cells in the radial extent.* While the tuber is expanding, fine strands of the vascular bundle are formed amongst the pith and storage cells. The bundle can be clearly traced entering the heel-end of the tuber from the stolon and sending branches into each eye or bud produced by the tuber. As the vascular cylinder is the part mainly concerned in distributing the sap which afterwards gives rise to starch, its amount is about the same in a stolon and in a tuber, but in the latter it forms an open meshwork rather than a closed cylinder. The pith forms the central part of the tuber and it is broadest near the middle. It gives off lateral branches, which communicate with the eyes, and it terminates at the apex of the tuber. The entire tuber is covered with a corky skin or periderm about 6 layers of cells deep in thin-skinned varieties, increasing up to about 10 cells in rough-skinned varieties. The skin is pitted with lenticels which have developed underneath the stomata of the young stolon tip. Under favourable conditions these become quite visible as white dots owing to a proliferation of their tissue. The lenticel performs the function of aeration.

The tuber is morphologically a shortened, thickened stem with scale leaves. In the axils of these leaves lie the eyes. Each eye is a collection of buds lying more or less in a depression. The number of buds in each eye may be great, but three is the usual figure. Actually, the eye is a lateral branch with undeveloped internodes. Thus it will be seen that the tuber is a branched shoot system and not a simple shoot. The spiral of the eyes is towards the left, but occasionally right-hand spirals are found. At the rose end or the apex of the tuber the eyes are more crowded than at the heel or stolon end.

* Antschwager, E. Studies of the Potato Tuber. *Jour. Agric. Research*, Vol. XXVII, No. 4.

A study of the characters of the tuber useful in diagnosis will be facilitated by first discussing differentiating points which are apparent during the growing season only and which disappear at maturity.

Potato breeders in appraising the value of their seedlings have always taken into consideration the proximity of the tubers to the mother plant. Hence it is that in very few varieties are tubers formed at a distance from the stems. Nevertheless, there exist amongst varieties differences in the plan of the tuber positions. Generally, early varieties form tubers near the surface. Some earlies, however, *e.g.*, Di Vernon, have this peculiarity developed to a very considerable extent, while others, *e.g.*, Eclipse, Witchhill and America tend to form tubers in tiers and they are thus not so readily exposed. Late varieties differ in their settings, few having tubers very close to the parent. Golden Wonder and Langworthy are types, however, which show a distinct disposition to deep tuber formation, while Templar, Dominion and Irish Chieftain having comparatively long runners, set tubers at some distance from the mother plant. The development of aerial tubers is characteristic of certain varieties. This phenomenon, known as supertuberation, is frequently due to accident, hence its occurrence may be associated with weakness of some kind in the haulm. It occurs frequently in Edzell Blue.

It has already been mentioned that the eyes of the potato tuber lie in the axils of scale leaves. These scale leaves are coloured in certain white-skinned varieties, the colour corresponding with that of the sprout and forming an extraordinarily useful feature in identification work. The scale leaves of May Queen, Conquest, Wilson's Seedling (338/2), Irish Chieftain, the Grey-leaved Rogue* and many other varieties are generally blue, while those of Fiftyfold are pink. It frequently happens in white varieties that the heel end of the tuber develops colour during the growing season as also does sometimes the rose end. The heel ends of Arran Chief and Abundance are blue, while those of Lymm Gray, Epicure and occasionally King George are pink. Immature tubers with pink rose ends are frequently found in Rhoderick Dhu and King George. The classification of tuber shapes shown on pp. 260-1 has been compiled from a study of matured, well-grown tubers. During the growing season, especially in July and early August, it is not always possible to form an accurate idea of the type, if small immature

* See *Miscellaneous Publications, No.* 3, Board of Agriculture for Scotland.

tubers only are available for examination. This difficulty is most pronounced in varieties with oval tubers.

The characters of the tuber which persist after maturity and which are useful in diagnosis are :—(1) Shape, (2) Colour and condition of skin, (3) Position and depth of eyes, (4) Colour and consistency of the flesh, (5) Type of second growth, and (6) Microscopic characters.

Shape.—Each variety has its typical tuber shape. Soil conditions, however, may greatly impair the development of this shape, the potato being apt to follow the line of least resistance. There is in consequence no rigidity of shape in any variety, and even on one plant several tuber forms may be found. Nevertheless, despite variations, a precise conception of the varietal type can be obtained usually by the study of a number of tubers, when the inconstant features are apparent. Except in spherical varieties each tuber has normally an upper and a lower surface. The upper surface practically always possesses more eyes than the lower and in most cases it is rounder than the latter. The true shape is visible when the tuber lies on its lower surface. When thus viewed, the tuber outline may appear round or to have a long axis. In the former case, the tuber may be spherical or pebble-shaped; in the latter it may be pear-shaped, oval or conical according as the largest diameter occurs towards the rose-end, about the middle or towards the heel end respectively. Tubers may be thin, thick or of medium depth according to the thickness of the cross section. Very frequently it is found that the stolon joins the tuber in a depression. When such is the case, the tuber is spoken of as having a recessed heel end, a condition prevailing in the following varieties :—America, Champion, Rocks, Early Pink Champion, Fortyfold, Buchan Beauty, Gregor Cups and Epicure. The depth of the recess is correlated with the depth of the eyes. Varieties with pear-shaped tubers seldom show the recess: indeed, these often exhibit the reverse character, namely, pointed heel ends, such as are common in King Edward. The classification on pp. 260-1 gives in tabular form the tuber shape of most common varieties. It must be kept in view that the finer the distinctions the more difficult it is to place the various types, especially if few tubers are available for examination. Generally, however, it is quite easy to relegate a variety to its position in the larger groups, viz., round, oval, conical or pear-shaped. Some long-oval and pear-shaped tubers show slight curving of the main axis, so that the tuber resembles a banana—a form frequently found in May Queen

Colour and Condition of the Skin.—Potato tubers may be coloured, parti-coloured, white or russet.

Coloured Tubers.—The colour of the skin is only fully developed when the plant reaches maturity. The intensity of the colour, however, depends largely on soil conditions—in sandy and peaty soils, the colour is usually highly developed, whereas in clay there is marked diminution of the intensity. The colour is at its highest in autumn and with age it fades slightly. The red and blue colouring is due to a pigment—anthocyan—dissolved in the cell sap of the periderm and the peripheral cortex. Distinctions may be drawn within each of the two groups. Thus Eightyfold is not so densely coloured as Edzell Blue, nor Arran Rose and Early Pink Champion so deeply as Flourball. The different tones and shades of colour cannot be described in words without reference to a chart, but with practice, the reader can readily familiarise himself with the various types and the modifications of these consequent on variations in soil. In some varieties, *e.g.*, Rector, the eye tissue is much more highly col-

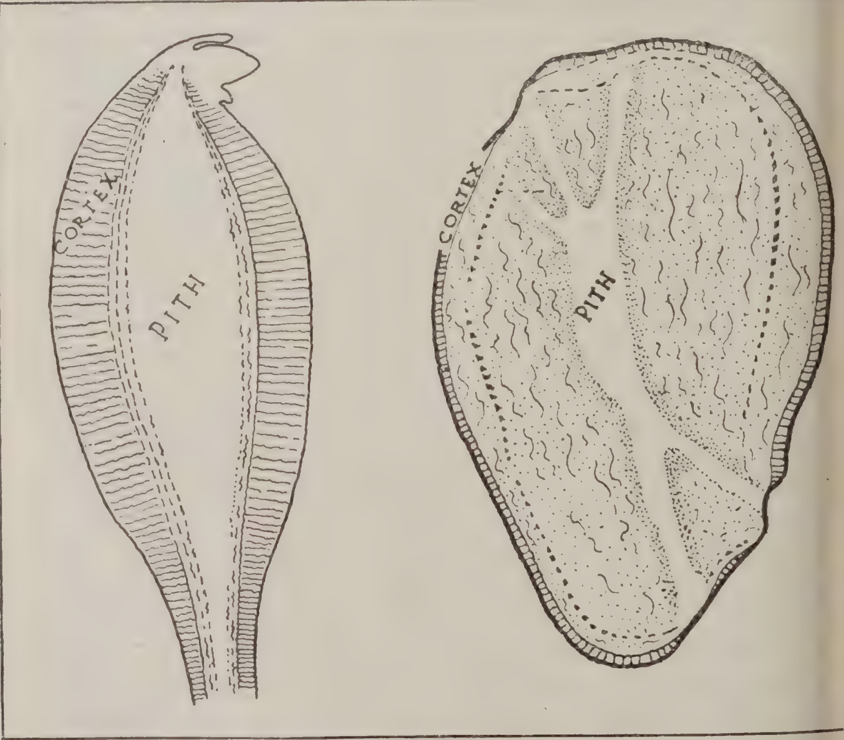

FIG. 1.—*Left*, Radial Section of Stolon Tip (x 9), and *Right*, Native Tuber (nat. size), showing homology of tissues (after Antschwager).

oured than the remainder, a characteristic quite useful for identification.

Parti-coloured Tubers.—In parti-coloured tubers the pigment is the same as described above; its distribution, however, is not uniform but localised, some of the skin being white. In most parti-coloured tubers the colour is situated mainly in the region of the eye, *e.g.*, Di Vernon, King Edward, K. of K., Katie Glover, Northern Star, Lochar, Catriona, and Beauty of Bute. In other varieties, *e.g.*, the Apple, this condition is reversed, the tissue about the eyes being white and the remainder coloured. Finer distinctions can be made in this group than in the previous one, and the basis of these distinctions is the relative amount of colour present. In some types, *e.g.*, Northern Star, Lochar and Marquis of Bute, the pigment develops in the region of the eyes and lenticels, but only faintly, if at all, elsewhere; others, such as Catriona, K. of K., Beauty of Bute and Katie Glover have more colour, but mostly concentrated about the eyes; in others again, the colour has a wider distribution, *e.g.*, King Edward, Buchan Beauty and Fortyfold. In the last-mentioned variety the coloured areas exceed the white areas in extent.

Both whole coloured and parti-coloured varieties are subject to occasional variations. Thus Di Vernon, Catriona and Arran Victory have been known to produce white tubers. King Edward, on the other hand, may give rise to whole-coloured tubers.

White Tubers.—The great majority of commercial varieties have what are known as white skins. The term " white " is apt to be misleading, as no variety has an absolutely white skin. However, it is used commercially to include a wide range of yellow shades. Varieties may be differentiated by the shade of yellow. Most yellow-fleshed varieties, especially where the colour is highly developed, have yellow skins, *e.g.*, Duke of York, Myatt's Ashleaf and Immune Ashleaf. Other varieties have pale yellow skins, as, for example, Great Scot. The greatest number, however, have skins which are even paler than the Great Scot type. Whiteness in tubers is due to the absence of visible pigment in the cork cells. On being exposed to light and air the tubers of many white varieties develop colour, *e.g.*, Epicure, Royal Kidney, Dean, Templar and Norna. This character is especially frequent in blue-sprouted varieties and the breeder must often discard seedlings because of this fault.

Russet Tubers.—Several commercial varieties have russet skins and for that reason are very easily identified. How

exactly these types arise is not known but it a noteworthy fact that each has its white-skinned homologue.

Tuber skins may be rough or smooth, depending on the thickness of the skin. The following varieties have smooth skins—Lochar, Marquis of Bute, King Edward and Witchhill; rough-skinned varieties are Duke of York, Gregor Cups and Ally.

Position and Depth of Eyes.—The eyes are always most concentrated at the apex of the tuber. The majority may be in a cluster on the tuber point or they may be grouped some distance from the point, in which case they are said to be on the shoulder. The remainder are distributed spirally over the tuber surface, the internodes becoming greater towards the heel end. The basal internodes are usually longer in pear-shaped and oval tubers than in conical tubers. In some varieties, *e.g.*, Epicure, King George, British Queen, and Early Market there is a distinct swelling below each eye. In such cases the tuber is said to have "raised eyebrows." The eyebrow itself often affords useful assistance; in Abundance, for example, it is long, while in Arran Comrade it is short. Some varieties, Great Scot, President and Rhoderick Dhu, may be distinguished from others, such as Ally, by having more numerous eyes. Eyes may be classified as deep, medium and shallow. In the first group are found Epicure, Champion, Rocks and Fortyfold; in the second, British Queen, King George, Kerr's Pink, Rhoderick Dhu and Great Scot; and in the last, Evergood, Templar, King Edward, Witchhill and Duke of York.

Colour and Consistency of the Flesh.—As with the skin, the flesh colour is only fully developed in the mature tuber. Varieties are described as having yellow, pale yellow and white flesh. Duke of York is a good example of the first type; Bishop of the second; and Edzell Blue of the last. Some varieties, especially when immature, are characterised by the frequent development of colour in the region of the vascular cylinder of the tuber. Herd Laddie and Flourball show this trait fairly constantly. Again, the cut surface of a few types turns rapidly red brown, a feature of special importance in Majestic and due to enzyme action. The consistency of the flesh is such that some varieties may be called soft and others hard fleshed—conditions which may be determined by cutting. Generally earlies have soft flesh and lates hard flesh, but exceptions exist. Comparisons, however, must be made with mature tubers and those free from virus or other diseases. As examples of early varieties, it may be stated that Puritan, Ninetyfold and May Queen have

softer flesh than Duke of York, while amongst lates, Langworthy and Crusader have harder flesh than Majestic or Nithsdale. It should be pointed out that much practice is necessary before one can make fairly definite decisions in this way.

Type of Second Growth.—The type of second growth is frequently very helpful in determining varieties, but its occurrence is not general, being dependent on the season, and can therefore be applied only in special cases. Second growth occurs where plants have commenced to ripen and where growth has been renewed by altered weather conditions. There are several distinct forms of second growth, viz., cracking, formation of secondary tubers, protrusions from tuber eyes and prolongation of the tuber axis. Cracking is a distinct feature of Ally and Scottish Chief. The formation of secondary tubers—separated from the primary ones by a length of stolon—occurs in Up-to-Date, Northern Star, Dominion, Pathfinder and Rhoderick Dhu. Protrusions from the eyes are found in British Queen, King George and Majestic. Prolongation of the tuber axis is found often in long but seldom in round potatoes. It occurs in British Queen, King George, Puritan, Catriona and occasionally in Golden Wonder. The flesh of the prolonged portion of Golden Wonder is generally lighter coloured than that of the remaining tuber tissue.

Microscopic Characters.—The ability to produce a large percentage of superior starch grains would appear to be varietal. Johnson and Boyle* have compiled a table showing the average size of the largest and medium size grains for many commercial varieties. Shamrock and Great Scot have large average grains while Early Rose and Royal Kidney have small average grains. It is to be noted, however, that size of grain varies with size of tuber, and tubers must be uniform to make the results comparable. In making such comparisons also it must be borne in mind that the largest grains are found generally in the tissue lying immediately adjacent to the vascular cylinder.

In a recent paper Artschwager† has shown that some varieties are characterised by having "stone cells." These are visible when sections through the region of the bud are examined microscopically. In other varieties such cells are wanting. In this connection nothing definite can be said about British varieties. Observations, however, are being made.

* "The Industrial and Nutritive Value of the Potato in Ireland." *Jour. Dept. of Agric. and Technical Instruction for Ireland*, Vol. XVIII, No. 4.

† *Journal Agric. Research*, Vol. XXVII, No. 11.

The Sprout.—Ripe tubers cannot be made to germinate before a certain time has elapsed. Varieties differ, however, in the period required—some, such as Early Pink Champion, May Queen, Duke of York, British Queen, Arran Chief, Rhoderick Dhu and Great Scot sprout readily, but others, including Arran Consul, Witchhill, Immune Ashleaf, Norna, Tinwald Perfection and Golden Wonder, are much slower in sprouting. The minimum temperature for germination is about 8° or 10° C. (46 or 50° F.). The cause of the resting and the processes which go on during that period are not accurately known. However, when germination begins, diastase and other enzymes are formed and the starch is converted into sugar. The latter is transferred to the growing sprout, where it is used in the formation of new tissue. The buds do not always develop equally; the most vigorous is the apical one. Apart from the rapidity of development there are distinct differences between varieties in the thickness of sprouts. Early Pink Champion, Great Scot, and America, especially the first mentioned, have thick sprouts; Evergood, King Edward, Majestic and Cardinal have thin sprouts. It has been stated recently* that within a variety the tubers with thick sprouts produce better crops than those with thin sprouts. Schander maintains† that a strong connection exists between capacity to sprout and subsequent yield; with numerous sprouts there is an increased yield. According to the same authority, the formation of sprouts in sound potatoes is dependent on the size of the tuber, *i.e.*, the number of sprouts increases with increasing size. The increase, however, is not great. In America thin sprouts have been associated with leaf roll. Such, however, has not been found to be the case in this country.

It is well known that the length of the sprout and the development of colour on it are influenced by light and moisture. In darkness long etiolated sprouts are formed on which the colour, if any, is very faint and confined to the lenticels. Moisture also appears to inhibit the development of pigment. In diffuse light the sprouts do not grow to the same extent and the colouring is much more marked, being partly green and partly red or blue purple. The green is due to the formation of chlorophyll, with which the cells underneath the colourless epidermis are filled. The red or blue colouring matter—anthocyan—is

* Snell, Dr. K., Keimungsprüfungen bei der Kartoffelknolle. *Deut. Landw. Presse.* 50, No. 7.

† *Landwirtschaftliche Jahrbücher.* Heft 3, Jan., 1924.

dissolved in the sap of the cells immediately underlying the epidermis. Chlorophyll is present also in the purple-coloured portions, but its presence is often obscured by the pigment. Even in the green parts purple is present in small quantities. The light green parts, however, contain no anthocyan. The root points are in general colourless. Grown in diffuse light, the colour of the sprout may be (1) Faint pink, *i.e.*, white or greenish-white with green tips, but generally showing a little pink, which increases at the base or at the tip on exposure. The variety, Ally, is a good example of this class (2) Pink, generally on a white or greenish-white ground, the colour at the tip being similar to the colour at the base. The greatest number of pink-sprouted varieties are to be found in this group (3) Blue or blue purple, when the tip and base are always a shade of blue. Generally the whole sprout becomes coloured. In all groups colour is always most intense at the lenticels.

In the existing schemes for the classifying of potato varieties the fundamental bases are the sprout colour, the maturity, and the tuber shape. However, during the growing season there is no sprout to examine, hence it is of importance to learn how the sprout colour may be inferred from a study of other parts of the plant. The following colour connections have been determined :—

(1) All plants having blue or blue purple predominating in the flowers have blue or blue purple sprouts.

(2) All plants having red or red purple predominating in the flowers have pink sprouts.

(3) The colour of the sprout corresponds with the colour, if any, on the tuber itself, including the scale leaves, or on the underground runners.*

These rules may not always be applicable; some varieties do not flower and others have white flowers; again, many varieties, especially earlies, have stolons on which as yet no colour has been observed. Nevertheless, as guides they are often very useful in the field.

Hairs are to be found on all normal sprouts and these have been used in separating varieties.† Sprouts may be grouped as follows :—(1)) Hairs frequent, *e.g.*, Duke of York and Arran Comrade, and (2) hairs few, *e.g.*, Great Scot and Arran Chief.

* An apparent exception to this rule is reported as occurring on a "sport" from Arran Victory.

† Davidson, W. P. "The Irish Seed Potato Trade, with some Notes on the Distinguishing Features of the Principal Varieties of Potatoes." *Jour. Dept. of Agric. and Technical Instruction for Ireland*, May, 1922.

Classification of the Tubers of some Common Potato Varieties.

1. White Tubers.

ROUND			LONG						
			OVAL			PEAR-SHAPED			CONICAL
White Flesh		Yellow Flesh	White Flesh		Yellow Flesh	White Flesh	Yellow Flesh	Pale Yellow Flesh	White Flesh
Pebble	Spherical	Spherical	Short	Long	Short				
Arran Comrade Great Scot Rhoderick Dhu *East Neuk* Burnhouse Beauty Ally *(a)* President General *Conquest*	Epicure America Rocks Bobbie Burns	*Champion*	*Templar* * *Abundance* † Evergood * *Irish Chieftain* ‡ Up-to-Date † Tinwald Perfection † Arrran Consul (*a*) ‡	Witchhill * Royal Kidney † Norna † Magnum Bonum † Majestic (*a*) ‡ *May Queen* ‡ *International Kidney* ‡	*Sharpe's Victor* *	*Langworthy* Sharpe's Express † Crusader † *Nithsdale* *	Duke of York *(a)* ‡ *Immune Ashleaf* † *Myatt's Ashleaf* † Dargill Early †	Bishop *(a)**	British Queen ‡ King George ‡ Puritan Ninety-fold ‡ Eclipse (*a*)†

2. Red Tubers.

ROUND			LONG			
			OVAL		PEAR-SHAPED	CONICAL
White Flesh		Yellow Flesh	White Flesh		White Flesh	White Flesh
Pebble	Spherical		Short	Long		
Kerr's Pink Flourball Reading Russet Shamrock Utility	Early Pink Champion Gregor Cups Sharpe's Pink Seedling	Rector Lord Rosebery Yam	Arran Rose † Ardneil Rose † Crimson Beauty †	Waverley *	Red King Edward (*a*) † Mr. Bresse* Cardinal †	Early Rose ‡

ROUND		LONG	
White Flesh		Pear-Shaped	
Skin Dark Purple	Skin Light Purple	White Flesh	Yellow Flesh
Edzell Blue *Arran Victory* Herd Laddie	*Eightyfold*	*Pride of Bute* ‡	*Keppleston Kidney* †

4. Parti-Coloured Tubers.

(The Skin may be White and Purple or White and Red)

	ROUND			LONG		
				Oval		Pear-Shaped
	White Flesh		Yellow Flesh	Short White Flesh	Long Pale Yellow Flesh	White Flesh
With A *PURPLE*	*Fortyfold* *Buchan Beauty*		*Purple Champion*		*Di Vernon* ‡ *Catriona* ‡	
With B *RED*	Eye Pink	Eye Red				
	Lochar Northern Star Marquis of Bute	Meins Early Round Beauty of Bute John Bull		K. of K. ‡ Katie Glover ‡		King Edward (*a*) †

5. Russet Tubers.

ROUND	LONG	
	Oval (Short)	Pear-Shaped
White Flesh	White Flesh	White Flesh
Village Blacksmith Brown Rocks	Field Marshal †	Golden Wonder †

Abbreviations:—* Thin tubers. † Tubers medium depth. ‡ Thick tubers.

Those varieties in *italics* have blue sprouts; the remainder have pink sprouts. Those varieties marked (*a*) are rather inconstant in shape

COUNCIL OF AGRICULTURE FOR ENGLAND.

THE Sixteenth Meeting of the Council was held on 21st May at the Middlesex Guildhall, Westminster. The Chairman for the year, Mr. James Donaldson, was in the Chair.

The Chairman read a letter from the Rt. Hon. Edward Wood, M.P., Minister of Agriculture, as follows :—

> "I have been honoured by a command to have an audience with His Majesty the King this morning at 11 o'clock, and I very much regret, therefore, that I shall be unable to attend the Meeting of the Council of Agriculture. Lord Bledisloe will be present and will be in a position to deal with any questions of policy which may arise in the course of your proceedings."

Statement by the Parliamentary Secretary.—*Lord Bledisloe* referred to the statement made by Mr. Wood at the last Meeting of the Council on 19th March, and said with regard to the Minister's independent consultations with the various agricultural organisations on the question of an agreed agricultural policy, that the Minister was genuinely hopeful that he might be able, with the aid of the suggestions made, to prepare an agricultural policy which would meet with a large measure of general consent. The British Sugar Subsidy Bill had received the Royal Assent and might do much to maintain arable cultivation on some of the light land in the Eastern Counties and elsewhere, and to increase employment both on farms and in factories. Three sugar factories were already at work, and it was expected that seven or eight more would be in operation before next winter. The Hop Control would cease in August, and a duty of £4 per cwt. on imported foreign hops had been imposed as part of the Budget proposals. A Bill to deal with Tithe Rentcharge on lines which it is hoped would be equitable both to tithe owners and tithe payers would shortly be introduced, as well as a Bill to deal with marking of imported agricultural produce, and also a Bill to facilitate a settlement between the Ministry and County Councils of the finance of the scheme for settling ex-Service men on the land. The Milk and Dairies Consolidation Act of 1915 would come into operation automatically on 1st September of this year, and would do so without the need of any repeal or amendment of the Act of 1922. The Tuberculosis Order of 1914 would come into operation on the same date, and a Bill was being prepared to enable the Treasury to refund to Local Authorities the same proportion of compensation in respect of the slaughter of tuberculous animals as was provided in 1914.

His Lordship added that it was not likely that any further measures relating to agriculture could be carried through this session of Parliament, though it was hoped that next year land legislation of a much more comprehensive character would be possible.

Dealing then with the question of Rural Housing, Lord Bledisloe said that the Ministry was in close touch with the Ministry of Health in the matter. There appeared to be a good prospect of cottage building in rural areas being accelerated in the early future. A great difficulty was to obtain skilled labour, and a Committee was at present considering proposals which would help in that direction. Under the Wheatley Housing Act, an increased subsidy had been provided in respect of new cottages erected in rural areas. The increased subsidy was £12 10s. for 40 years in place of £6 for 20 years under the previous Act. It was estimated that, with the aid of the Local Authorities' contribution, it should be ordinarily possible to let a house which cost £425 at about 4s. a week. 105 Rural District Councils had already adopted the scheme. A Committee of the Ministry of Health was now investigating new methods and types of house-construction. These types were being built in various centres throughout the country for demonstration purposes. County Councils were also empowered to lend money to persons desirous of altering or reconstructing old houses.

As regards the Rating of Small Holdings, the Ministry had acted on the suggestion of the Council at its last meeting and had sent a Circular Letter to Clerks of County Councils throughout England and Wales indicating means by which small holders could be assisted in getting a reduction of their assessments where they were rated on a higher level than occupiers of neighbouring land.

Another question to which the Council attached importance was a new Sheep Scab Policy. This question had been before the Agricultural Advisory Committee, and might be expected to be ready for the Council's consideration at its next Meeting.

In reply to *Mr. J. S. Gibbons* (Gloucs.), *Lord Bledisloe* said that the Ministry's Land Drainage Bill was in draft, though it was doubtful whether it could be passed during the current session. *Mr. Gibbons* also enquired as to the erection of more houses on small holdings. *Lord Bledisloe* replied that that would come under the new Small Holdings Policy to be inaugurated next year. In reply to *Mr. F. J. K. Cross* (Berks), *Sir Francis Floud* said that the present scheme

for small holdings would go on until 1st April, 1926, though it was not possible for the Ministry to authorise very much additional in the way of capital expenditure between now and that date because the funds allowed under the Act had been practically fully spent or committed. *Col. Courthope, M.P.* (East Sussex) asked whether any means had been found of extending to all really rural areas the higher scale of subsidy for housing provided by the Wheatley Act for rural parishes. *Lord Bledisloe* replied in the negative, and indicated that the definition of an "agricultural parish" in the Act would require amendment if that object was to be achieved. *Major Hotchkin* (Lindsey), *Mr. W. B. Taylor* (Norfolk), *Mr. R. W. Hall* (Hereford), *Major Fawkes* (West Riding) and *Mr. H. Dent-Brocklehurst* (Gloucs.) asked further questions in regard to Rural Housing and Unemployment Drainage Schemes.

Capt. E. T. Morris (Herts.) moved a hearty vote of thanks to the Parliamentary Secretary for his very interesting statement. This was seconded by *Mr. H. E. S. Upcher* (Norfolk), put to the meeting, and carried unanimously.

Allotments Legislation.—The Chairman of the Standing Committee (*The Rt. Hon. F. D. Acland*) moved the adoption of the Report on Allotments, which welcomed the Allotments Bill recently introduced, and trusted that the principles contained in it would be the basis of legislation in the present session of Parliament. The Report emphasised the following points as being of importance for the permanent well being of the movement:—

1. The facilitation of the provision of allotments in schemes of town planning.
2. Easy access to vacant land for allotment purposes.
3. Reasonable notice and compensation to allotment holders when quitting their plots.
4. The availability of advances from the Public Works Loan Board to to properly constituted allotment societies for the purpose of purchasing allotment land.
5. The simplification of arbitration proceedings in cases where compensation has to be paid in taking allotment land.
6. The direct representation of allotment holders on allotment committees, and direct access for the reports of such committees to the Councils of Local Authorities.

Sir Douglas Newton supported the motion. *The Chairman* said that it might be helpful to the Government if the Council added a suggestion that the present Bill should be made a Government Bill. This suggestion was agreed, and the Report adopted.

Swine Erysipelas.—*Mr. Acland*, on behalf of the Standing Committee, moved the adoption of its Report on this subject, which was carried.

Co-operative Marketing of Co-operative Produce.—*Mr. Acland*, on behalf of the Standing Committee, moved the adoption of its Report which called attention to the publication recently issued on this subject by the Ministry. *Mr. Hawk* (Cornwall) enquired whether the Ministry could assist Counties which were organising a central station for the grading, marking and marketing of agricultural produce. *Lord Bledisloe* said that for successful co-operation the initiation must come from the farmers, and the less Government intervention as a general rule the better. Still, the Ministry could assist certain co-operative schemes financially and would do their utmost within the limits of those powers.

Special Committee on Agricultural Policy.—*Mr. Acland*, on behalf of the Standing Committee, moved :—

> "That in view of the Minister's invitation to the Council of Agriculture to submit proposals for consideration as to a future Agricultural Policy, the Council should appoint a Special Committee to draw up proposals for submission to the Council."

He referred to the Memorandum, which had been circulated with the Agenda, setting out alternative methods proposed by the Standing Committee :—

> 1. That the Chairman and Ex-Chairmen of the Council (Lord Selborne, Sir Douglas Newton, Mr. George Edwards and Mr. Donaldson) be asked to be members of the Committee and to co-opt not exceeding seven other members to complete the Committee, and
>
> 2. That nominations be now made from the Council for a Committee of eleven persons; if more than eleven are nominated, a ballot to be taken.

He said that the Council would no doubt first of all decide as to whether the Standing Committee was right in suggesting that a Committee should be formed to discuss policy, and then signify which of the two alternatives, or if neither of them, what other alternative plan should be adopted for setting up that Committee. *Mr. Rea* (Northumberland) seconded the Resolution, but suggested that the alternative methods of setting up the Committee should be merged, so that the four gentlemen should be members of a Committee, the others of which should be chosen by the Council. *The Chairman* first put the resolution, which was carried unanimously. *Mr. Bruford* (Somerset) seconded Mr. Rea's proposal. *Mr. Woodhead* moved as an amendment that the first alternative suggested by the Standing Committee should be adopted. *Mr. H. W. Thomas* (Hants.)

seconded. *Sir Merrik Burrell* (West Sussex) supported. *Mr. Hawk* suggested a compromise. *Mr. Spraggon* (Durham) asked whether it was necessary that persons to be co-opted should be members of the Council. *The Chairman* replied that they should. Mr. Woodhead's amendment was then put to the meeting and carried.

Joint Animal Diseases Committee in each County.—*Sir Merrik Burrell* moved :—

> "That this Council regrets that Capt. Pretyman's Committee in their recent report on Foot-and-Mouth Disease should have departed from the recommendation of the former Committee that there should be only one Committee in any one geographical County for certain objects in connection with animal diseases, that Committee to consist of representatives from County Councils, County Boroughs and Boroughs within the area of any one County. The Council attaches great importance to having only one authority for Diseases of Animals administration in each County, and therefore reaffirms its resolution of 22nd February, 1924."

Mr. Hamilton (Lancs.), *Mr. George Nicholls* (Soke of Peterborough), and *Lord Bledisloe* discussed the matter, and His Lordship said that a draft Bill, more or less on the lines of Sir Merrik Burrell's resolution, had been prepared by the Ministry and was now under consideration by the County Councils' Association and the Association of Municipal Corporations. The resolution was put and carried unanimously.

Imported Superphosphates.—*The Rt. Hon. Lord Strachie* moved :—

> "That this Council is opposed to the application of the Fertilisers Manufacturers Association for the imposition of a duty upon imported superphosphate."

Mr. R. G. Patterson (Staffs.) seconded. *Mr. Geo. Edwards* and *Mr. Haman Porter* supported the resolution and *Col. Courthope* and *Mr. H. W. Thomas* opposed it. The resolution was then put to the meeting and carried.

Somersetshire Teart Lands.—*Lord Strachie* moved:—

> "That the Minister of Agriculture be requested to make experiments in connection with the feeding of animals on teart or scouring lands."

He stated that the Somersetshire Agricultural Committee was anxious to know what progress had been made in the experiments which the Ministry had already arranged, and that, in the view of that Committee, future experiments should not be confined to hay from teart land. *Mr. Hamilton* seconded the Resolution, which was carried unanimously. *Lord Bledisloe* said that the Ministry was not yet in a position to say whether the disease was a specific disease, or whether the effects were due to some form

of malnutrition caused by the herbage or the quality of the soil of teart land. The question was one in which the Bristol University College, as the advisory centre for the district, might be useful in carrying forward further investigations on the land itself.

Rural Housing.—*The Rt. Hon. F. D. Acland* moved:—

> "That in order to encourage Rural District Councils to use their powers under the Housing (Financial Provisions) Act of last year, the Council of Agriculture would welcome increased assistance being offered from the Exchequer to those Councils which have used their powers under this Act to assist the building of cottages to the extent of a penny rate, so that in respect of further cottages, the subsidy required from the rates would be halved."

He drew attention to the Memorandum from the Standing Committee which accompanied the resolution, in which the finance of rural housing under the Wheatley Act was carefully explained. The resolution was duly seconded and was spoken to by *Mr. A. R. White* (Wilts.), *Capt. Morris*, *Mr. Spraggon*, *Mr. Rea*, *Mr. Upcher*, *Mr. H. C. Gardner* (Worcs.), and *Sir Merrik Burrell* and put to the meeting and carried unanimously.

Dominion Foodstuffs in Great Britain.—*Lord Strachie* moved:—

> "That this Council is opposed to the granting of £1,000,000 yearly to the Dominions to enable them to assist the marketing of their food products in Great Britain to the detriment of the British Farmer."

Mr. Hamilton seconded the resolution. *The Rt. Hon. Edward Wood, M.P*, Minister of Agriculture, said that it was not to be assumed that the grant in question must necessarily involve damage to the British Producer. This country had to import a certain amount of its supplies from abroad and the object was to endeavour, within that amount, to substitute Dominion goods for Foreign goods. In the debate in the House of Commons last December, the Prime Minister had said:—

> "I want to repeat once more that it is the hope of the Government that this money could be used to enable the Dominions to secure a larger share of that part of the Home market which has to be supplied by importation from abroad. The Dominions have always recognised that our home producers have, and always should have, the first place in the Home market, but they ask, and we think rightly ask, that they should have a preference over foreign countries as regards that part of the Home market which cannot be supplied by the home producer."

The Chancellor of the Exchequer in the same debate said:—

> "Great care will have to be taken in the administration of this policy to make quite sure that we do not in so doing do an injustice to our own domestic agricultural producers. We wish to encourage the Empire

products at the expense of the foreign product, but not at the expense of the domestic producer."

No expenditure under this head could be incurred until the necessary vote had been passed by the House of Commons and proposals would first have to be considered by the Imperial Economic Committee and the Cabinet. In view of the Minister's speech, *Lord Strachie* said he would ask the Council's permission to withdraw his motion and substitute a motion in the following sense :—

"That this Council is not opposed to the granting of one million pounds a year for marketing Colonial produce in this country, provided that the British producer is not undersold in the British Market in consequence of that grant."

Sir Douglas Newton seconded and *Mr. Ashby* moved an amendment as follows :—

"That this Council is of opinion that whatever sum may be provided by the Imperial Government for the improvement of marketing of Empire produce should be devoted proportionately to the improvement of marketing of British and Dominions produce."

Mr. Matthews (Hereford) seconded, *Mr. Christopher Turnor, Mr. Hamilton, Mr. Dallas, Mr. Spraggon, Mr. Bruford, Mr. Rea* and *Mr. Patterson* spoke on the matter and *Mr. Rea* gave notice of a further amendment as follows :—

"That this question be referred to the Committee on Agricultural Policy that has been formed, with a request that they give it special consideration in their Report to be presented to the next meeting of this Council."

Mr. Geo. Edwards seconded this amendment.

Mr. Ashby's amendment was first put to the meeting and carried. It then became the substantive resolution on which *Mr. Rea's* amendment was proposed. Mr. Rea's amendment was then put to the meeting and carried.

County Fees for Certain Certificates.—*Mr. R. W. Hall* moved :—

"That the question of fees for certificates under the Rent Restriction Act and the Agricultural Holdings Act, 1923, be referred to the Standing Committee to consider whether a general recommendation ought not to be made for uniformity in such fees in all Counties, and report to this Council at its next meeting."

Mr. Gardner seconded, and the resolution was put to the meeting and carried.

Report from Agricultural Advisory Committee.—*Mr. Dallas* moved the adoption of the Report (No. 10) of the Proceedings of the Agricultural Advisory Committee in England and Wales which was put to the meeting and carried.

AGRICULTURAL ADVISORY COMMITTEE FOR ENGLAND AND WALES.

REPORT (No. 10) to the Councils of Agriculture for England and Wales on the Proceedings of the Agricultural Advisory Committee:—The present report covers the proceedings at three meetings, namely those of 4th March, 1st April, and 6th May.

At the first of these meetings the news was brought to the Committee of the death of one of their colleagues, Mr. John Roberts, a representative from the Council of Agriculture for Wales. The Committee expressed their deep regret and instructed that a message of sympathy and condolence be sent to the family.

(1) **Agricultural Conference.**—At the meeting on the 4th March, the Committee was informed of the announcement, then recently made, by the Minister in regard to his alternative that representatives of the three sections of Agriculture should be consulted separately with a view to the formulation of an agreed policy which might be acceptable to successive Governments.

(2) **Register of Movements of Live Stock.**—A preliminary draft Order was considered by the Committee providing for a Register of Movement of Live Stock which it had been suggested would be useful for tracing animals in outbreaks of Foot-and-Mouth Disease The Committee considered that it would be very difficult to bring into such a Register the ordinary dealer in live stock unless he were licensed, and they were not in favour of proceeding with the draft Order until this difficulty had been overcome.

(3) **Tuberculosis Order.**—It was reported to the Committee that the Government had decided that the financial terms contemplated in connection with the Tuberculosis Order of 1914 should be revived. This involved the Exchequer finding 75 per cent. of the compensation paid for slaughter in cases of advanced tuberculosis. It was intended that a Bill should be introduced into Parliament and the revived Order brought into operation under it at the same time as the postponed Milk and Dairies Act of 1915 was put into force.

(4) **Merchandise Marks Bill.**—The Committee was consulted in regard to the Government proposals to adopt the Merchandise

Marks Bill, under which certain kinds of imported produce, including chilled meat, frozen meat and fresh meat, bacon, hams, eggs, cheese, and honey were proposed to be marked with the name of the country of origin. The Committee suggested that poultry might be included.

(5) **Sugar Beet Research.**—The question was raised of the possibility of finding Government assistance for Sugar Beet Research. On behalf of the Ministry, certain difficulties in the matter were pointed out, and it was stated to be doubtful whether the industry was as yet in a stage to make it worth while to go to any large expense in research. A Sugar Beet Plant Research Institute would be costly, and similar Institutes on the Continent at the present time were the outcome of 60 years of steady investigation and improvement. The Ministry would, however, carefully consider the question.

(6) **Land Drainage Bill.**—The preliminary draft of a Land Drainage Bill was considered by the Committee at its meeting on 1st April. This Bill proposed to transfer certain existing powers from the Ministry to the Local Authorities, and also to give power to County Coucils to compel an owner whose default or omission in not cleaning his drains and ditches was holding up water, to get the work done, or for the Local Authority to proceed with it at the cost of the owner. The Committee pointed out that undue responsibilities might devolve upon riparian owners for he upkeep of banks above tidal waters, and asked that further consideration might be given to the point.

At the next meeting on the 6th May, the Ministry brought forward proposals for extending the right of appeal by riparian owners in those cases where others unrated or uncharged might benefit by the drainage works required to be done under the particular clause under discussion at the previous meeting. The Committee agreed that the draft Bill, amended to safeguard riparian owners in this way, might be approved.

(7) **Foot-and-Mouth Disease.**—The Chief Veterinary Officer reported on 1st April that there were then only three scheduled areas remaining, namely, in Cheshire, in the Isle of Wight and in Sheffield. The Cheshire outbreak was due to a case of concealment of disease, and the farmer had been prosecuted and fined £88 and costs. The question was raised as to whether it was a right and proper thing for compensation to be paid to

such an owner for the slaughtering of diseased stock, and the Committee was informed that the matter had been considered and would be again looked into.

(8) **Foot-and-Mouth Disease Committee's Report.**—The Report was circulated for the information of members of the Committee. The Committee drew attention to paragraph 171 of the Report, which stated the view that the idea of a Joint control of animal disease was hardly possible of attainment, and should therefore be abandoned. The Advisory Committee, however, after consideration of the matter were not in agreement with this view.

(9) **Local Authorities Regulations under Foot-and-Mouth Disease Order, 1895.**—The terms of a draft Order which the Ministry proposed to make requiring Local Authorities to submit Orders regulating the movement of cattle in their counties to the Ministry for approval before issue were agreed.

(10) **Draft Imported Animals Order.**—The Committee also approved the draft of an Order which provided that an occupier or person in charge of premises where imported animals are brought under licence for detention should give the Ministry's or the Local Authority's Inspector all reasonable assistance and facilities for the examination of the animals in order to ascertain whether they had been marked in accordance with the Act or the Ministry's Order as to tagging.

(11) **Sheep Scab.**—At the meeting of the 6th May, the outlines of the proposed policy of eradication in the case of sheep scab were placed before the Committee, and it was agreed that a draft Order embodying them should be circulated to the members for consideration and discussion at a later meeting.

*   *   *   *   *   *

JUNE ON THE FARM.

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Arable Land.—In the northern counties the swede crop is sown during May and land that cannot be got ready before June is drilled with common turnips. In the southern and some of the midland counties, swedes sown before June are liable to

become " mildewed " later in the summer, as a result of which the crop loses its leaf and suffers considerably in yield. Mildew is a term commonly applied to both the white mould and the grey aphis forms of infestation, but both pests appear to be associated with a check in the growth of the crop, lack of moisture generally being the chief trouble. Common turnips and certain varieties of swede, for instance Eclipse Purple Top, are not so susceptible to the white mould form of mildew as are Bangholm and certain other varieties. As regards the aphis, dry spraying with a dust containing 5 per cent. of nicotine sulphate has been found to be effective in American trials. The same treatment might also be expected to reduce depredations of the black aphis or " smother fly," which often attacks mangolds.

June is regarded as a good time for sowing grass and clover seeds under cover of rape on land that has received a half fallow. On hill farms where sheep are kept, outlying fields can be kept in fair condition without yard manure and root growing, if artificial manures are applied liberally to the rape crop and this is fed off with sheep. Indeed, with the help of phosphates and wild white clover, a rich clovery sward is obtained, which when ploughed under will supply all the nutriment required by two corn crops. Charlock, however, may introduce difficulties in this method of management.

With a view to making an early start with the hay harvest, farmers like to make rapid progress in June with the work of cleaning and singling the root crops. Moreover, early cleaning and singling is an important factor in the growth of good crops of roots. The damage done by weeds and surplus plants is not limited to their shading effect; they compete with the crop plants for plant food and moisture. All young plants are voracious feeders, gathering food in anticipation as it were of future needs, and many weeds send down their roots more quickly than the crop plants among which they grow. Side-hoeing by hand is both expensive and slow, yet many farmers do not make use of the special devices which are available for this operation, and in consequence their root crops are grown at greater cost and trouble than is necessary.

Thistles.—Two species of thistle have been scheduled as Noxious Weeds, which it is the duty of County Agricultural Committees to control by means of notices served on the occupiers of land on which these weeds are permitted to grow unchecked. The Spear Thistle (*Carduus lanceolata*) is a common

weed of pastures, but. not having underground runners, its eradication is only a matter of preventing seeding. The Creeping Thistle. however, is very persistent and spreads both by seeding and by means of underground runners. Pulling is the best way of checking it amongst corn, and the aim should be to extract as long a piece of root as possible. If merely spudded, especially if spudded early in the season, two or more thistle shoots may appear in place of the one that was cut off. In pasture land the common practice of mowing creeping thistles once a year does little towards reducing their numbers; it does prevent the blowing of thistle down, however, if the mowing is done early enough; but it is futile to mow after all other work has had attention and the thistles have flowered. Cutting twice, or better three times, in the season, beginning while the first shoots are only about 4 to 6 inches high, as they are in June, is the most effective method so far discovered for dealing with this pest. Trials which brought out the effectiveness of repeated cutting were carried out at the Harper Adams College in 1907—1910 and again at Cockle Park in 1917—1920. The treatment has to be continued over two and if necessary three seasons to ensure complete eradication, and it is important that the first cutting of the season should be done while the plants are small. Meadows are rarely infested with thistles, and shutting a field up for hay two years in succession is a good method of getting rid of not only thistles but also a number of other weeds which infest pasture land.

Quality of Milk.—While experiments generally reveal only small differences in the composition of milk yielded by cows receiving different rations, averages of large numbers of samples show that the fat content of milk is appreciably lower while the cows are out at grass than while they are indoors. The following figures represent the average of 714 samples taken by the Derbyshire Official Sampler and analysed by the County Analyst during the year 1924 :—

Quarter ended—	Fat. Per cent.	Non-fatty Solids. Per cent.	Total Solids. Per cent.
March ...	3.73	8.73	12.46
June ...	3.59	8.79	12.38
September	3.54	8.76	12.30
December	3.99	8.80	12.79
Average for year ...	3.72	8.77	12.49

During June of last year. two cases came to notice in which the mixed milk of the herds contained less than 3 per cent. of

fat. In both cases the farmers were endeavouring to correct the trouble by inducing the cows to consume large quantities of cake, but without beneficial effect. Individual samples showed that certain cows were yielding very poor milk. By milking these very early in the morning and after the rest of the herd in the evening and by paying special attention to clean stripping, and probably as a natural improvement with advance of lactation, the trouble was gradually overcome.

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MONTHLY NOTES ON FEEDING STUFFS.

E. T. HALNAN, M.A., Dip. Agric. (Cantab.),
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The Nutritive Ratio of Feeding Stuffs.—The nutritive ratio, or as it was formerly called, the albuminoid ratio, of feeding stuffs, is of value to the stock feeder, since it helps him to classify feeding stuffs according to their relative richness in protein. This is important, since the aim of the stock feeder is so to compound his ration that the mixture fed contains the requisite amount of protein blended with the right amount of energy producing foodstuffs. The amounts of protein and energy required by animals vary according to the age of the animal, and the purposes for which the animal is designed. Thus, the nutritive ratio of the ration of a cow being fattened for slaughter should differ considerably from that required for a cow intended for milk. It is, therefore, very important that all stock feeders should be able to work out for themselves the exact nutritive ratio of a mixture of feeding stuffs. Simple though such an operation appears at first sight, it is not so, and many feeders, often unconsciously, make mistakes in working out the nutritive ratio of a ration. Particularly is this the case with poultry keepers, who normally feed the ration to poultry in two distinct mixtures, a grain feed generally alternating with a mash feed.

There are two methods available in calculating the nutritive ratio of a ration. The first, or long method, is rather a tedious operation. The nutritive ratio of the ration is arrived at by adding to the percentage of digestible carbohydrates and fibre the percentage of digestible oil multiplied by 2.3, and dividing the resultant sum by the percentage of crude protein present. Thus, in the case, say, of a pig feed consisting of 60 per cent. maize meal, 25 per cent. barley meal, 10 per cent. middlings, and 5 per cent. fish meal, the result would involve the following calculation :—

	Composition digestible ingredients.			Total ingredients.		
	Protein	Fat	Carbs. and Fibre	Prot.	Oil	Carbs. and Fibre.
lb. Maize meal ...	7.1	3.9	67.0	.071 × 60	2.3 × 0.39 × 60	60 × .67
lb. Barley meal ...	6.5	1.2	64.7	.065 × 25	2.3 × 0.12 × 25	25 × .647
lb. Middlings ...	13.2	4.5	49.2	.132 × 10	2.3 × .045 × 10	10 × .492
lb. Fish meal ...	50.0	4.2	—	.5 × 5	2.3 × .042 × 5	—
Total ingredients of ration in lb. ...				9.7	7.59	61.3

$$\therefore \text{ Nutritive Ratio} = \frac{68.89}{9.7} = 1 : 7 \text{ approx.}$$

The arithmetical calculations, which it will be seen are somewhat prolonged, have been left out, the totals only being given.

By the short method of calculating the nutritive ratio advantage is taken of the fact that tables of analyses generally give the nutritive ratios of the individual feeding stuffs. For the purpose of the calculation, all one requires is a knowledge of the total digestible crude protein and the nutritive ratio. By multiplying the digestible crude protein by the nutritive ratio the sum of the carbs. + fibre + oil × 2.3 is obtained. Thus :—

	Digestible Nutrients		Total ingredients	
	Prot.	N. Ratio.	Prot.	Oil × 2.3 + Carbs. × Fibre
60 lb. Maize meal ...	7.1	1 : 11	.071 × 60	.071 × 60 × 11
25 lb. Barley meal ...	6.5	1 : 10	.065 × 25	.065 × 25 × 10
10 lb. Middlings ...	13.2	1 : 5	.132 × 10	.132 × 10 × 5
5 lb. Fish meal ...	50.0	1 : 0.2	.5 × 5	.5 × 5 × .2
Total ingredients			9.7	67.21

$$\therefore \text{ N. Ratio} = \frac{67.21}{9.7} = 1 : 7 \text{ approx.}$$

We thus arrive at the same result, having considerably reduced the arithmetic.

A common mistake in calculation is to ignore the actual amounts of digestible protein present, and to calculate the nutritive ratio of the ration from the nutritive ratios only of the individual foods. This leads to serious error, as will be evidenced if we take the example given above. Thus :—

			Total ingredients	
		N. Ratio.	Prot.	Oil × 2.3 + Carbs. + Fibre
60 lb. Maize meal	...	1 : 11	60	660
25 lb. Barley meal	...	1 : 10	25	250
10 lb. Middlings	...	1 : 5	10	50
5 lb. Fish meal	...	1 : 0.2	5	1
			100	961

$$\therefore \text{ N. Ratio} = \frac{961}{100} = 9.61 \text{ instead of } 7.$$

A similar mistake can be made by poultry keepers in neglecting the actual digestible protein present in the mash and grain

DESCRIPTION.	Price per Qr.		Price per Cwt.	Price per Ton.	Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.
	s. d.	lb.	s. d.	£ s.	£ s.	£ s.		s.	d.
Wheat, British - -	—	—	12 8	12 13	0 16	11 17	71·6	3/4	1·78
Barley, British Feeding	—	—	10 0	10 0	0 12	9 8	71	2/8	1·43
" Canadian :—									
No. 3 Western	—	—	—	—	—	—	—	—	—
" 4 "	37/9	400	10 7	10 12	0 12	10 0	71	2/10	1·52
" American	37/9	"	10 7	10 12	0 12	10 0	71	2/10	1·52
" Danubian	37/9	"	10 7	10 12	0 12	10 0	71	2/10	1·52
" Karachi - -	37/9	"	10 7	10 12	0 12	10 0	71	2/10	1·52
Oats, English, White -	—	—	10 4	10 7	0 13	9 14	59·5	3/3	1·74
" " Black and Grey -	—	—	10 0	10 0	0 13	9 7	59·5	3/2	1·70
" Scotch, white -	—	—	—	—	—	—	—	—	—
" Canadian :—									
No. 2 Western -	31/3	320	10 11	10 18	0 13	10 5	59·5	3/5	1·83
Argentine -	27/3	"	9 6	9 10	0 13	8 17	59·5	3/0	1·61
Chilian - -	28/9	"	10 1	10 2	0 13	9 9	59·5	3/2	1·70
Maize, Argentine - -	44/6	480	10 5	10 8	0 13	9 15	81	2/5	1·29
" Australian -	44/6	"	10 5	10 8	0 13	9 15	81	2/5	1·29
Beans, English Winter -	—	—	10 9	10 15	1 12	9 3	67	2/9	1·47
" Chinese " -	—	—	11 6	11 10	1 12	9 18	67	2/11	1·56
Peas, English Maple -	—	—	11 4	11 7	1 8	9 19	69	2/11	1·56
" Japanese - -	—	—	23 0	23 0†	1 8	21 12	69	6/3	3·35
Rye, Homegrown - -	—	—	11 0	11 0	0 16	10 4	71·6	2/10	1·52
Dari, Egyptian - -	—	—	10 6	10 10	0 15	9 15	75·2	2/7	1·38
" Persian - -	—	—	11 3	11 5	0 15	10 10	75·2	2/10	1·52
Millers' Offals :—									
Bran, British - -	—	—	—	7 10	1 7	6 3	45	2/9	1·47
" Broad - -	—	—	—	8 17	1 7	7 10	45	3/4	1·78
Middlings—									
Fine Imported	—	—	—	9 7	1 2	8 5	72	2/4	1·25
Coarse, British	—	—	—	8 7	1 2	7 5	64	2/3	1·20
Pollards, Imported -	—	—	—	7 10	1 7	6 3	60	2/0	1·07
Meal, Barley - -	—	—	—	12 0	0 12	11 8	71	3 2	1·70
" Maize - - -	—	—	—	10 15	0 13	10 2	81	2/6	1·34
" " South African	—	—	—	9 12†	0 13	8 19	81	2/2	1·16
" " Germ -	—	—	—	9 7	0 19	8 8	85·3	1/11	1·03
" " Gluten Feed	—	—	—	10 5	1 7	8 18	75·6	2/4	1·25
" Locust Bean -	—	—	—	9 15	0 9	9 6	71·4	2/7	1·38
" Bean - - -	—	—	—	13 0	1 12	11 8	67	3/5	1·83
" Fish - - -	—	—	—	20 10	4 7	16 3	53	6/1	3·26
Linseed - - -	—	—	—	22 7	1 11	20 16	119	3/6	1·87
" Cake, English 12% Oil	—	—	—	13 17	1 18	11 19	74	3/3	1·74
" " 10% Oil	—	—	—	13 0	1 18	11 2	74	3/0	1·61
" " 9% Oil	—	—	—	12 17	1 18	10 19	74	3/0	1·61
Soya Bean " 6 % Oil	—	—	—	11 5	2 14	8 11	69	2/6	1·34
Cottonseed Cake, English 5½% Oil	—	—	—	8 7	1 15	6 12	42	3/1	1·65
" " Egyptian 5½% Oil	—	—	—	8 0	1 15	6 5	42	3 0	1·61
Decorticated Cotton Seed Meal 7% Oil -	—	—	—	11 7	2 14	8 13	74	2/4	1·25
Ground Nut Cake 7% Oil	—	—	—	9 10*	1 16	7 14	56·8	2/8	1·43
Palm Kernel Cake 6% Oil	—	—	—	7 15†	1 3	6 12	75	1/9	0·94
" " Meal 2% Oil	—	—	—	8 0	1 4	6 16	71·3	1/11	1·03
Feeding Treacle - -	—	—	—	7 2	0 8	6 14	51	2/8	1·43
Brewers' Grains :—									
Dried Ale - -	—	—	—	7 7	1 4	6 3	49	2/6	1·34
" Porter - -	—	—	—	6 17	1 4	5 13	49	2/4	1·25
Wet Ale - - -	—	—	—	1 1	0 9	0 12	15	–/10	0·45
" Porter - -	—	—	—	0 15	0 9	0 6	15	–/5	0·23
Malt Culms - -	—	—	—	8 5†	1 14	6 11	43	3/1	1·65

† At Liverpool. * At Hull.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at April and are, as a rule, considerably lower than the prices at local country markets, the difference being due and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at Its manurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. D again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quote market. The manurial value per ton figures are calculated on the basis of the following unit prices :—N, 13s. ; P K_2O, 2s. 6d.

mixtures respectively, even though the nutritive ratio of the grain and mash mixture has already been worked out correctly. Thus, take a mash mixture consisting of 4 parts bran, 2 middlings, 1 part Sussex ground oats, 1 part maize meal, 1 part fish meal. The nutritive ratio of this mixture works out at 1 : 3.1, and every lb. of the mixture contains .15 lb. digestible protein. Similarly a grain mixture consisting of 1 lb. oats, 1 lb. maize, 1 lb. wheat has a nutritive ratio of 1 : 8.1, and every lb. of the mixture contains .084 lb. digestible protein.

If equal quantities of the mash and grain are fed, the true nutritive ratio will be as follows :—

	Dig Prot.	N. Ratio.	Dig. Prot.	Oil × 2.3 + Carbs.
Mash ...	.15	1 : 3.1	.15	.15 × 3 1 = .465
Grain ...	.084	1 : 8.1	.081	.084 × 8.1 = .680
		Total ingredients	.231	1.145

$$\therefore \text{ N. Ratio} = \frac{1.145}{.231} = 1 : 4.9$$

If the actual digestible protein present in every lb. of the mash and grain mixture is ignored the following conclusion will be arrived at :—

	N. Ratio.	Dig. Prot.	Oil × 2.3 + Carbs.
Mash ...	1 : 3.1	1	3.1
Grain ...	1 : 8.1	1	8.1
	Total ingredients	2	11.2

$$\therefore \text{ N. Ratio} = \frac{11.2}{2} = 1 : 5.6 \text{ instead of } 1 : 4.6.$$

* * * * * *

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat -	1·29	2 5	71·6	8 7	0 16	9 3
Oats -	1·29	2 5	59·5	7 4	0 13	7 17
Barley -	1·29	2 5	71·0	8 12	0 12	9 4
Potatoes -	1·29	2 5	18·0	2 4	0 4	2 8
Swedes -	1·29	2 5	7·0	0 17	0 2	0 19
Mangolds -	1·29	2 5	6·0	0 15	0 3	0 18
Beans -	1·29	2 5	67·0	8 2	1 12	9 14
Good Meadow Hay -	1·34	2 6	31·0	3 18	0 14	4 12
Good Oat Straw -	1·34	2 6	17·0	2 3	0 7	2 10
Good Clover Hay -	1·34	2 6	32·0	4 0	1 0	5 0
Vetch and Oat Silage -	1·34	2 6	14·0	1 15	0 7	2 2
Barley Straw -	1·34	2 6	19·5	2 9	0 6	2 15
Wheat Straw -	1·34	2 6	11·0	1 8	0 4	1 12
Bean Straw -	1·34	2 6	19·0	2 8	0 9	2 17

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	Average Price per ton during week ending May 13th.				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13.12	13.15	12.15	12.17	16. 7
,, ,, Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, ordinary (N.20.7 per cent.)	13.11*	13.11*	13.11*	13.11*	(N)13.1
,, ,, ,, neutral (N. 21.1 per cent.)	14.14*	14.14*	14.14*	14.14*	(N)13.11
French Kainit (Pot. 20 per cent.)	3. 2	3. 0	...	2.15	2. 9
,, ,, (Pot. 14 per cent.)	2.17	2.15	2. 5	2,10	3. 7
Potash Salts (Pot. 30 per cent.)	...	...	3.15	3.15	2. 6
,, ,, (Pot. 20 per cent.)	...	...	2.10	2.12	2. 7
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7.10	7. 2	7. 5	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	11. 5	11.10	4. 9
Basic Slag (T.P. 30 per cent.)	...	...	2.12§	...	...
,, ,, (T.P. 28 per cent.)	...	2. 1‡	...	...	...
,, ,, (T.P. 26 per cent.)	...	1.14‡	...	...	...
,, ,, (T.P. 24 per cent.)	...	1.11‡	2. 0§	...	...
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 8	1.11
,, (S.P. 30 per cent.) ...	3. 7	3. 2	3. 8	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8. 0	8.10	8. 0	...
Steamed Bone Flour (N. ¾. T.P. 60 per cent.)	6. 7†	6.12†	6.10	5.17†	...
Fish Guano (N. 7½-8¼. T.P. 16-20 per cent.)	...	...	13. 0	...	...
,, ,, (N. 9, T.P. 10 per cent.) ..	...	...	...	12. 5	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station. London prices are for 4-ton lots. ‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named, and at London are for not less than 4-ton lots. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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MISCELLANEOUS NOTES.

Coccidiosis of Chickens.

COCCIDIOSIS is caused by the multiplication of a small animal parasite (*Eimeria tenella*) in the tissues of the intestines. This disease, which is second only in importance to bacillary white diarrhœa, is found in every species of bird, both domesticated and wild. It is particularly prevalent among chicks and turkey poults and causes very heavy losses.

The parasite has a very complicated life cycle and reproduces both sexually and by division into segments. At one period of its life it is able to live for a long time on the ground and is

very resistant to disinfectants, and for this reason the eradication of the disease from poultry farms is difficult.

Two forms of the disease occur, an acute form in chickens, and a chronic form in adult birds.

The acute form attacks chickens from 10 days to 2 months old. The younger the chicks the greater is the mortality, which in closely confined flocks kept under bad sanitary conditions may reach 100 per cent. The symptoms shown are not characteristic of the disease and are very similar to those seen in bacillary white diarrhœa. When a heavy mortality occurs in a hatch *after* the 10th day it points strongly to coccidiosis. The disease cannot be diagonised either by the symptoms observed during life or by the naked eye appearances of the internal organs seen at post-mortem examination. A definite diagnosis can be made only on finding the parasite by a microscopical examination of the contents of the intestines. In adult birds the disease occurs in a chronic form and is usually the sequel of an acute attack as chicks. The affected bird harbours the parasites which are passed out in the fæces in great numbers, the ground and food become contaminated and from these sources chickens pick up the disease.

Attempts at treatment have not given very satisfactory results. Crude catechu, in the drinking water, is the most effective method. It is given in the proportion of one-third teaspoonful to a gallon of water.

It may be laid down as a general principle for the contagious diseases of poultry that the value of a fowl is too small to pay for the time and labour expended on individual treatment. The aim of every poultry keeper must be the prevention and not the cure of contagious disease. Use high, well-drained, clean land for rearing young stock, and avoid overcrowding; keep all appliances thoroughly clean; supply clean water in troughs in which it cannot be contaminated by droppings.

All newly purchased birds should be isolated for one month and observed frequently during that period before introduction to the healthy flock. Chickens under three months old should not be allowed in contact with adult fowls.

When coccidiosis occurs the affected birds and those in contact with them should not be moved to fresh ground. If the outbreak is not widespread it is probably best to destroy the survivors and disinfect the houses and runs. Contaminated runs should be treated with quicklime, dug up and re-limed and left vacant for one year. When this is not practicable the

runs should be sprayed with 5 per cent. commercial sulphuric acid and left vacant for 14 days. This method is effective against the parasite but has the disadvantage of destroying all vegetation.

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Farm Workers' Minimum Wages.

MEETINGS of the Agricultural Wages Board were held on 21st April and 5th May at Gwydyr House Annexe, Whitehall, S.W.1, Mr. J. Willmot, P.P.S.I., acting as Chairman in the absence of Lord Kenyon. The Board considered notifications from various Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions :—

Berkshire.—From 27th April to 30th September, 1925, minimum rates of wages for female workers under 19 years of age, the rate in the case of workers aged 18 to 19 being 4½d. per hr. (Rates for female workers over 19 are already in operation.)

Cumberland and Westmorland.—Minimum and overtime rates of wages for male workers and minimum rates of wages for female workers from 31st May (when the present Order expires) to 22nd May, 1926. The new Order provides for an increase of 1s. per week in the wages of workers hired on half-yearly or yearly engagements, and in the case of other male workers, an increase of 1s. per week in winter and 2s. 6d. per week in summer. The rates in the case of male workers aged 21 and over will become, in the case of workers hired on half-yearly or yearly engagements 38s. per week of customary hours (62 hr.), and in that of other male workers (other than casual workers) 31s. per week of 48 hr. in winter (1st November to the last day of February) and 32s. 6d. per week of 54 hr. in summer (remainder of the year).

The Order also provides that wages for adult male workers in casual employment shall be 8d. per hr., and that the minimum wage for female workers aged 18 and over should be 5½d. per hr.

Derbyshire.—Minimum and overtime rates of wages for female workers from 11th May to 15th December, 1925, the minimum rate in the case of such workers aged 18 and over being 5d. per hr., with overtime at 8d. per hr. for employment on Sundays.

Dorset.—Special overtime rates of wages for employment on the hay and corn harvests in the present year, the rate in the case of male workers aged 21 and over being 10d. per hr.

Durham.—From 14th May (when the present Order is due to expire) to 13th May, 1926. Continuation of existing rates except for an amendment by which the extra payment to horsemen of 21 years and over who are not householders and are not boarded and lodged by the employer is increased from 1s. 10½d. to 3s. 6d. per week.

N.B.—In the case of male workers aged 21 and over the minimum rates for the country are as follows:—

Horsemen: 32s. for 50 hrs. and any additional time spent in attention to horses, with an extra payment to such workers who are householders of 7s. per week, and to workers who are not householders and are not boarded and lodged by the employer of 3s. 6d. per week (as from 13th May).

Stockmen and Shepherds: (a) Householders 43s. per week; (b) workers who are not householders and are not boarded and lodged by the employer 37s. 10½d. per week; (c) workers who are boarded and lodged 36s.; the wages in each case to cover the hours customarily spent in attention to stock.

Other Adult Male Workers: 32s. per week of 50 hrs.

Hereford.—From 1st May (when the previous Order expires) to 30th April, 1926. The new Order fixes a special minimum rate for male workers aged 21 and over employed wholly or mainly as bailiffs, waggoners, stockmen or shepherds of 36s. per week for all time necessarily spent in the immediate care of animals (not exceeding 60 hours). The minimum rate for other classes of male workers aged 21 and over remains unchanged at 31s. per week of 48 hrs. in winter (November to February), and of 54 hrs. in summer (remainder of year), and no change is made in the rates for younger male workers or for female workers.

Kesteven and Lindsey.—From 27th April to 15th February, 1926. Minimum rates of wages for male workers under 21 years of age employed wholly or mainly as waggoners, the rates for workers aged 20 and under 21 being 30s. per week of 48 hrs. in winter and 52 hrs. in summer with an additional payment of 7s. per week to cover time spent in connection with the care of horses.

N.B.—Minimum rates on a similar basis are already in force for waggoners aged 21 and over.

Somerset.—From 27th April to 29th September, 1925. Overtime rates for male workers and minimum rates for female workers, the overtime rate for male workers aged 21 and over being 7½d. per hr. for the first hour of overtime employment on week days and 9d. per hr. for subsequent weekly overtime employment and all employment on Sundays. The minimum rate fixed for female workers aged 21 and over is 6d. per hr.

Wiltshire.—From 27th April to 11th October, 1925. Reduction of the minimum hourly rates of wages for female workers under 18 years of age to 4½d. for workers aged 17 to 18, 3½d. for workers aged 16 to 17; 3d. for workers aged 15 to 16; and 2½d. for workers aged 14 to 15 years.

Anglesey and Carnarvon.—Minimum and overtime rates of wages for male workers and minimum rates of wages for female workers from 14th May (when the present Order expires).

The new Order continues the present rates unchanged, the rates being in the case of male workers aged 21 years and over (a) horsemen, cowmen, shepherds or hwsmyn (bailiffs) 35s. per week of 58 hrs.; (b) other male workers 30s. per week of 50 hrs. and, in the case of female workers aged 18 and over, 6d. per hr.

Denbigh and Flint.—From 11th May to 15th February, 1926. Minimum and overtime rates of wages for female workers, the minimum rate in the case of such workers aged 18 and over being 5d. per hr., with overtime at 6¼d. per hr.

Glamorgan.—From 11th May, 1925, to 1st March, 1926. Special minimum rates of wages for male workers employed wholly or mainly as stockmen, cattlemen, cowmen, horsemen, shepherds or bailiffs, the rates being for workers aged 21 and over 40s. per week of 60 hrs. The minimum rates for other classes of male workers and for female workers remain unchanged, being in the case of male workers aged 21 and over 37s. 6d. per week of 53 hrs. in summer (1st March to 31st October) and 51 hrs. in winter (remainder of the year).

Merioneth and Montgomery.—From 2nd May (when the previous Order expires) to 1st May, 1926. The new Order increases the minimum rates of wages for male workers aged 21 and over by 6d. per week, the rates from the 2nd May being for stockmen, teamsters, carters or shepherds 34s. 6d. per week of 60 hrs. and for other adult male workers 31s. 6d. per week of 54 hrs. The minimum rates for male workers under 21 years of age and for female workers remain unchanged.

Radnor and Brecon.—From 3rd May (when the previous Order expires) to 14th February, 1926. The weekly rate for male workers aged 21 and over remains unchanged at 31s., but with variation in the number of hours in respect of which it is payable, the hours becoming 54 instead of 52 in summer (15th February to 14th October) and 48 instead of 50 in winter (rest of the year).

Copies of the Orders in full can be obtained on application to the Ministry.

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Goats in England and Wales.

THE Ministry has obtained from its Crop Reporters returns of the number of goats in each parish in England and Wales. These returns show that the number of goats in January, 1925, was practically 60,000. To some extent the returns were estimates, but as they were based on a considerable amount of local inquiry they may be taken as fairly reliable, and their accuracy is corroborated from another source. While the Crop Reporters were collecting information on which to frame their estimates the Ministry asked members of the British Goat Society to furnish returns of the number of goats which they owned, and to give estimates of the number in their parishes or in adjoining parishes with which they were well acquainted. Estimates in respect of 1,000 parishes were obtained in this way and agreed very closely with those furnished by the Crop Reporters for the same parishes.

On the whole more goats are kept in the east and south-east of England than in other parts of the country. The four

counties in which the largest numbers are kept are Essex, Norfolk, Hampshire and Durham, in each of which there were between 3,000 and 4,000 goats, Kent, Cambridge (including the Isle of Ely), Suffolk and the West Riding of Yorkshire had between 2,000 and 3,000, and the East Riding of Yorkshire, Surrey, Sussex, Berkshire, Buckingham, Gloucester, Wiltshire, Somerset, Dorset, Devon, Yorkshire, N.R., Lancashire, Cardigan and Carmarthen had between 1,000 and 2,000. As regards Wales, the great bulk of the goats kept are in the south, nearly 5,000 being returned for the six southern counties against rather less than 1,000 in the north.

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Importation of Plants into Canada.

THE Canadian Government have asked the Ministry to remind nurserymen and others concerned in this country that hay, straw or fodder must not be used as packing material for goods exported to Canada unless a certificate of sterilization, or an official certificate stating that the hay, straw or fodder came from an area free from foot-and-mouth disease, is attached to the container. The term "fodder" is interpreted in its widest sense and includes chaff, rice-hulls, buckwheat hulls and practically everything that might come into contact with live stock.

Exporters of plants, bulbs, etc., to Canada are accordingly advised to pack their consignments only in such materials as clean sphagnum moss, excelsior, wood-wool, shavings, sawdust, and similar materials.

* * * * * *

Swan Quills.

THE Ministry understands that swan quills, the importation of which into the United Kingdom is prohibited by certain of the provisions of the Importation of Plumage (Prohibition) Act, 1921, are required by makers of artists' brushes and fishing tackle in this country. The quills are shed naturally once a year, and it is desirable that these supplies should be made available for manufacturing purposes.

The Ministry would be glad to put any persons who have or may have supplies of such quills in touch with possible buyers. This can also be done in the case of goose, turkey and duck quills, the importation of which is not, however, prohibited. Letters should be addressed to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, S.W.1, quoting Reference No. T.B. 185.

The Care of New Woodlands.

LARGE areas of land throughout the country are being planted with trees by the Forestry Commission. This year between 15,000 and 16,000 acres have been planted and 30,000,000 young trees have been put into the ground amid suitable conditions for growth and development. Next year the programme extends to 18,000 fresh acres, and much of the land which is being dealt with in this way is situated in places frequented by tourists. It is hoped that everyone will realise that these new forest areas are public property and will help to protect and care for the young plantations and woods that they may grow into an asset of great importance to the nation. This is the intention with which these plantations are being made, for owing to the serious inroads made during the War into our supplies of growing timber, our woods were sadly depleted.

The greatest enemy is fire, and a carelessly dropped match or cigarette end may be the cause of widespread ruin and loss. Young plantations are extraordinarily inflammable, and fires, although so easy to start, are extremely difficult to check and extinguish. Where a fire is lighted in the vicinity of any woods or plantations it is earnestly requested that great care should be exercised to put out the embers completely before the place is left.

Broken glass is also a source of danger, for the pieces lie sometimes in a situation in which they focus the sun's rays and act as a burning glass. Many destructive forest fires have been commenced in this way, and this is only one of the reasons why glass bottles should never be left strewn about or broken up out of doors.

If all people will co-operate, the danger of forest fires is reduced enormously, and a little forethought is all that is necessary. The woods which will result from the efforts now being put forth will be a grand legacy to the future, and a source of endless delight to lovers of the countryside and profit to the nation as the trees develop and mature.

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Foot-and-Mouth Disease. There was no development of disease in the Wadsley Bridge outbreak and all restrictions in that district have been withdrawn. The second outbreak referred to in the May issue of the *Journal* was confirmed on premises at Great Houghton, Northampton, on 19th April. Disease was also confirmed on adjacent premises on 30th April, whilst other outbreaks occurred at Overstone, near Northampton, on 6th May, and at Rugby a day later, all the cases having an indirect connection. This has subsequently been reduced.

The usual restrictions have been imposed in connection with these outbreaks.

An outbreak of disease also occurred at Hampton, near Malpas, Cheshire, on 5th May, necessitating the application of restrictions to an area within 15 miles radius.

Since 1st January, 1925, 21 outbreaks have occurred, in 9 counties, involving the slaughter of 784 cattle, 349 sheep, and 560 pigs, and the payment of £30,452 in compensation.

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NOTICES OF BOOKS.

Profitable Bush Fruit Culture.—(J. W. Morton, F.N.I.A.B., F.R.H.S. London: Ernest Benn, Limited. Price 2s. 6d.) This little book provides an account of the cultivation under commercial conditions of what are known as "bush fruits," *i.e.*, gooseberries, black, red and white currants, and raspberries. It is disappointing to find loganberries, an established commercial crop, omitted from a book of this nature.

A chapter is devoted to each crop and is divided into sections dealing with soils, varieties, pruning, manuring, propagation, pests and diseases, and marketing. Two chapters are given to such subjects as summer pruning, birds, tools and implements, while the final division of the book consists of a useful calendar of operations.

The sections dealing with cultural operations are representative of sound commercial practice. Those on manures are a little fragmentary in character. Some useful information is given in the sections dealing with varieties. In connection with raspberries no reference has been made to the widespread confusion of nomenclature, and that at least three, if not more, distinct varieties are distributed as Baumforth's Seedling, and similarly in regard to the Hornet variety.

The statement, on page 6, that "black currants belong to a separate family to red and white currants" seems to be a misleading method of stating that the black, red and white currants are distinct species of one genus. That gooseberries are usually grown on a single stem will come as a surprise to Kentish growers, who have long been in favour of the stool bush system. True it is that the leg bushes are the most suitable for the high-class dessert varieties, which require hard pruning in order to obtain quality, but most experienced growers will eschew this system where the main object is the production of green berries.

The sections devoted to descriptions of pests and diseases are particularly complete and some useful remedies are given.

In his opening chapter the author lays emphasis upon the importance of exercising care in the purchase of fresh stock when forming new plantations. He reiterates this when discussing the so-called "reversion" disease of black currants, and prospective growers of this crop will do well to take this advice to heart.

Written in simple, colloquial language, this little book forms a useful guide to the cultivation of these crops and constitutes a fit companion volume to the rest of this series of practical handbooks issued by the publishers.

Eléments de Pathologie Végétale Appliquée à l'Agronomie et à la Sylviculture. (E. Marchal. Gembloux: Jules Ducolet; and Paris: Libraire Agricole de la Maison Rustique. 1925.) This volume is the second of a series published under the auspices of the Bibliothèque Agronomique Belge, and designed to extend a knowledge of the results of higher agricultural teaching and research in plant

and animal technology to those who are most directly concerned in the industry on its practical side. From this point of view, therefore, the book is to be looked upon as a more or less popular exposition of modern plant pathology. The author has for nearly thirty years held the position of State Phytopathologist in Belgium, and should, therefore, be well qualified to write with authority on the diseases of cultivated plants and trees, which commonly occur in that country. In addition he deals with some of the diseases of plants cultivated in the tropics (Belgian Congo), such as those of cocoa, rubber, sugar cane and cotton

The book, of just over 300 pages, is divided into three parts. Part I, which occupies about five-sixths of the whole, deals with diseases due to parasites of vegetable origin. In the first chapter the nature of parasitism itself is discussed and the legislative, cultural, prophylactic and therapeutic measures in general use are set forth. The second chapter, a long one of over 200 pages, contains detailed descriptions of the diseases caused by bacteria, slime-fungi, fungi, algæ and lichens, and includes a short account of the chief phanerogamic parasites, such as mistletoe, dodder, and so on. The diseases are arranged according to the parasites which cause them, and measures of control are suggested in each case. In chapter 3 some eight or nine pages are devoted to the subject of virus diseases, such as Leaf Roll and Mosaic in potato, Mosaic in tobacco and tomato, and the Sereh disease of sugar cane. So-called physiological diseases are treated of in Part II, where the effects of external factors, such as soil, heat, light, air, meteoric agencies, etc., on the health of the plant are rather briefly summarised. The third Part consists of an analytical table or key in which, under the various hosts, brief descriptions are given, by the aid of which the chief diseases can be diagnosed in a preliminary way, and reference then made to the fuller descriptions in the body of the work.

There are about 150 illustrations, some original but others taken from various sources in Europe and America, some of them being from the English Ministry's publications. Many of them are from halftone blocks, but owing probably to the unsuitable character of the paper on which they are printed, the results often leave a good deal to be desired on the score of clarity.

The book is, of course, not intended for advanced students and no references to literature are provided.

It is interesting to find it stated that Wart Disease of the potato has not yet been found in Belgium, although from a German source it has been suggested that it was present near Ypres during the war. Onion Smut is rather rare and does little damage there, whilst the reported existence in Belgium of *Endothia parasitica*, the fungus which has almost exterminated the Sweet Chestnut in the eastern part of the United States, has not been confirmed.

Year Book and Annual Report of the Essex County Farmers' Union, 1925.—(Chelmsford, 2s. 6d. net.) This annual well maintains the high standard set by its edtior in previous years. In addition to all the information that an Essex farmer would expect to find in his year book, it contains a large number of excellent articles, which make up a volume that every farmer, in whatever part of the country he may live, would find one of the best half-crown's worth he could hope to acquire.

A very few of the articles can be mentioned here. The Hon. E. G. Strutt, in "The Future of Agriculture," by a brief survey of the trend

of wheat and live stock prices appears to point to a prospect of better things to come for British agriculture. "A Review of Agricultural Research," by Professor Wood, describes briefly the large amount of research which has been carried out since the war, with a few striking examples of results achieved. The manner in which research is really influencing the practical work of farmers is well suggested by this article. "Prehistoric Crops," by Professor Sir R. H. Biffen, contains an interesting account of grain—wheat, barley, oats and beans—dug up in prehistoric villages in the West Country that were inhabited 2,000 years ago, before the Roman occupation. Articles on "Agricultural Education in Essex" and "The Work of the Official Seed Testing Station" show the useful work for agriculturists now being done respectively by a progressive County Council and a National Institution. "Village Life," by the Countess of Warwick, and "The Enclosures and their Bearing on Modern Problems," by J. L. Hammond, discuss similar problems of country life from different points of view and reach most stimulating conclusions.

The last that can be mentioned here is an article on "Poultry-keeping for the General Farm," by C. A. Flatt, which mainly compares the advantages of egg production and the sale of pullets, both branches well adapted to the conditions of a general farm, but the former requiring considerable capital expenditure for the profitable branch of winter egg production and the latter needing little capital. A large number of other articles which cannot be mentioned here are equally suggestive and will repay study by all farmers.

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ADDITIONS TO THE LIBRARY.

Agriculture, General and Miscellaneous.

Branson, E. C.—Farm Life Abroad: Field Letters from Germany, Denmark and France. (310 pp.) University of North Carolina Press; London: Oxford University Press, 1924, 9s. [63 (43) (489) (44).]

Dunlop, J.—Scotsmen Farming in England. (48 pp.) Kilmarnock: "Standard" Printing Works, 1925. 1s. 6d. [63(42).]

Farrow, E. P.—Plant Life on East Anglian Heaths: Observational and Experimental Studies of the Vegetation of Breckland. (118 pp. + xxiii pl.) Cambridge: University Press, 1925, 7s. 6d. [58.19(42).]

Rolfe, R. T. and *Rolfe, F. W.*—The Romance of the Fungus World: An Account of Fungus Life in its Numerous Guises both Real and Legendary. (329 pp. + xxxi pl.) London: Chapman & Hall, 1925, 12s. 6d. [63.24.]

Sanson, J.—La Prévision du Temps en Agriculture. (320 pp.) Paris: J. B. Baillière, 1925. [551.5.]

Crowther, C.—Some Problems in the Assessment of Residual Manurial Values of Feeding Stuffs and Fertilisers. (22 pp.) Reprint from *The Journal* of the Auctioneers' and Estate Agents' Institute, April, 1925. [63.1624.]

Foster, L. F.—Principles and Practice of Farm Book-Keeping: A Text-Book for Agricultural Students. (484 pp.) London: Gee & Co., 1925, 15s. [657.]

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Paterson, W. G. R. (edit.).—Farm Crops. (Four volumes.)
Vol. I. Grain Crops. (365 pp.)
II. Root Crops. (313 pp.)
III. Pastures and Hay. (314 pp.)
IV. Miscellaneous Crops. (323 pp.)
London: Gresham Publishing Co., 1925, £2 10s. the set. [63.3.]

Leeds University and the Yorkshire Council for Agricultural Education.—Bulletin 140 :—Tests of Varieties of Wheat at the Manor Farm, Garforth, and in the North and East Ridings of Yorkshire, 1922-24. (36 pp.) Leeds, 1925. [63.311-194.]

Welsh Plant Breeding Station.—Bulletin Series H, No. 4 :—Studies Concerning the Pollination, Fertilization and Breeding of Red Clover, by *R. D. Williams.* (58 pp.) Aberystwyth : University College of Wales, 1925, 3s. 6d. [63.33(6).]

National Institute of Agricultural Botany.—Varieties of Potatoes, with their Synonyms, immune from and susceptible to Wart Disease, tested at the Potato Testing Station, Ormskirk, from 1915-1924. (31 pp.) Cambridge : Heffer, 1925, 1s. 6d. [63.512-194.]

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Duke, W.—Mushroom Culture. (88 pp.) London : Lockwood Press, 1925, 1s. [63.518.]

California Agricultural Experiment Station.—Bulletin 381 :—Growing and Handling Asparagus Crowns. (34 pp.) Berkeley, 1924. [63.511.]

Turnbull, J.—Fruit Growing Do's and Don'ts. (56 pp.) London : Methuen, 1925, 2s. 6d. [63.41.]

Live Stock.

Salop County Council.—Leaflet 18 :—Report on Pig Feeding Experiments, 1924. (*a*) Wet *versus* Dry Feeding.
(*b*) Whey *versus* Water.
(4 pp.) Shrewsbury, 1925. [63.64 : 043.]

Dairying.

World's Dairy Congress.—Proceedings of the World's Dairy Congress, October, 1923. Two volumes (1,600 pp.) Washington : Government Printing Office, 1924, $2.50. [63.70(06).]

Leeds University and the Yorkshire Council for Agricultural Education.—Bulletin 138 :—Dairy Farming on Arable Land. (54 pp.) Leeds, 1925. [63.711.]

Veterinary Science.

Medical Research Council.—Special Report Series No. 94 :—Tuberculin Tests in Cattle, with Special Reference to the Intradermal Test. (196 pp.) London : H.M. Stationery Office, 1925, 3s. [614 : 54.]

Poultry and Bees.

Kentucky Agricultural Experiment Station.—Bulletin 252 :—Calcium Metabolism in the Laying Hen. II. (36 pp.) Lexington, 1924. [63.651 : 043.]

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Snodgrass, R. E.—Anatomy and Physiology of the Honeybee. (342 pp.) New York and London : McGraw-Hill Publishing Co., 1925, 17s. 6d. [63.81.]

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NOTES FOR THE MONTH.

Register of Dairy Cattle.

VOLUME 8 of the Ministry's Register of Dairy Cattle will be published early in July and will contain particulars of cows recorded under the Ministry's Scheme during the year ended 1st October, 1924. It is hoped that the alterations that have been made in the conditions of entry and in the arrangements for issue will tend to increase the value and usefulness of the Register.

The principal modifications in regard to entry in and issue of the Register are that entries are not now confined to cows in respect of which certificates have been issued and applications for entry have been made by their owners, nor is any charge made for Volume 8 to members of Milk Recording Societies as has previously been the case. The Register will be issued free to them, and to many Agricultural and other Societies and Institutions interested in the Dairy Industry. The sale price of the Register is only 1/-, and it can be obtained from H.M. Stationery Office, at Adastral House, Kingsway, London, W.C.2, or through any Bookseller.

As a result of the imposition in 1921, on grounds of economy, of a charge of 5/- for a certificate, there has been a considerable decrease annually in the number of cows entered in the Register. There were only 1,321 entries in Volume 7, and these did not include many of the high-yielding cows because they had not been certificated.

Under the altered conditions of issue of Volume 8, particulars will be published of 5,000 of the cows recorded under the Ministry's Scheme which have the highest yields according to the standards prescribed for their breeds.

These standards are as follows:—

Friesian	10,000 lb.
Ayrshire, Blue Albion, Lincoln Red Shorthorn, Red Poll, Shorthorn and Crossbred	9,000 lb.
All other breeds or types ...	8,000 lb.

Approximately 13,000 cows out of 138,000 recorded reached these standards, but considerations of space and cost of publication have prevented the inclusion of more than 5,000 of them in Volume 8. It is hoped, however, that it may be found possible to increase the number of entries in future Volumes of the Register if financial conditions permit.

Approximately 62 per cent. of the cows entered in the Register are Shorthorns. With the exception of Friesians, which account for 17 per cent., no other breed is represented by more than 3 per cent. Of the 4,764 members who recorded during the year ended 1st October, 1924, approximately 41 per cent. own cows which appear in the Register.

In addition to the entries of the cows mentioned the Register contains particulars of cows in respect of which Certificates of Merit have been issued, and of Pedigree Bulls whose dams and sires' dams have reached the prescribed yields for their breeds.

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Clean Milk Competitions.

IT is estimated that during the present year nearly 1,000 dairy farmers will take part in the clean milk competitions that are being organised by County Education Authorities under the guidance and with the financial assistance of the Ministry. Thus, quite a number of producers will be engaged in paying special attention to their methods of milk production, stimulated by the hope of a challenge cup, or a medal or a certificate.

The benefits of a clean milk competition are not limited to the gaining of awards. Their more permanent value is the educational work which the competition carries with it. Under the stimulus of the prospect of gaining a high place, producers lend a ready ear to the suggestions of dairy advisers and are brought face to face with the things that matter in clean milk production. Perhaps more important still, the milkers and other farm employees have their interest awakened, and acquire an enlightened outlook.

The competitions consist in the taking of fair samples of the farmer's milk at regular intervals, and the examination of these samples for bacterial content, keeping quality, fat and sediment; the equipment and condition of the cowhouse and milk-room are also taken into account, and surprise visits are made by the inspecting judges. The County Educational staff give advice throughout the competition, and periodical reports are issued to the competitors, giving counsel based on the results of examining samples up to date.

The day of the public meeting at which the cup and other wards are distributed, is the gala day for a good many farmers 1 the neighbourhood, and those who are not fortunate enough) receive a certificate have at any rate the satisfaction that ley can try again next time, and that meanwhile, as all names 1 the competition are confidential, no publicity is given to ny except the leading contestants.

The benefits of these competitions may be briefly considered. 'irst, as to the public. The competitions form one of the best leans of bringing about an improvement in the cleanliness of le milk supply. If milk is clean, it is safer, sweeter, and in very way more desirable. In this country much more milk ught to be consumed; the consumption is much greater in such ountries as Denmark and the United States. One reason why onsumption of milk remains low is that consumers are suspicious f its cleanliness. There is an ever-growing section of the comunity prepared to pay a slightly better price for a cleaner rticle. Sometimes, the publicity that comes from taking a ading place in a competition may in itself be sufficient to nable a producer to build up a retail trade amongst this class consumer. More generally, he must first take out a Ministry Health licence for the production of Grade A milk. Clean milk mpetitions have often been the means of showing farmers lat they can produce milk of this standard solely by attention details, and with little or no capital outlay on building or quipment.

The Ministry would like to see this movement extend over ery milk-producing area in the country. In localities where competition is contemplated and where dairy farmers wish to ive one, they should get their Union or Society to approach e Local Education Authority and ask for one.

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Export of Live Stock for Breeding.

A statement is published in this issue of the *Journal*, p. 379, owing the number and value of cattle, sheep, and swine exrted from Great Britain and Northern Ireland for breeding purposes, and the countries to which they were sent, during the three months ending 31st March, 1925.

The tables which appear in the Monthly counts relating to Trade and Navigation give the figures for imals consigned to a few countries, classing the remainder

under the heading "other countries." Since 1st April, 1923, however, the animals sent from Great Britain and Northern Ireland to the Irish Free State have been treated as exported and have been included in the figures for the "other countries." The result is that the ordinary commercial stock transactions which take place between this country and the Irish Free State are included with the export of high-class stock for breeding purposes.

The Ministry will, therefore, in future publish quarterly in this *Journal*, a table (compiled from figures supplied by the Customs and Excise Department) showing in as much detail as possible, the countries to which stock are exported, and the average declared value of the animals, giving separately the figures for those sent to the Irish Free State.

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Important Judgment with Reference to the Seeds Act, 1920.

AN important judgment with reference to the Seeds Act was delivered by Judge Farrant at Peterborough on 31st March, in a case in which a farmer was sued for the price of some maple peas, and in which he set up the defence that the plaintiff had failed to deliver a statement in writing containing the prescribed particulars as to variety, percentage of germination, purity, etc., as required under the Seeds Act, and that the contract for the sale and purchase of the seed was therefore illegal and unenforceable. Judge Farrant decided that this defence was a sound one, and delivered judgment for the defendant with costs.

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A Residential College for Land Workers.

A RESIDENTIAL college for land workers, which has been constituted on a somewhat novel basis, has recently been opened in Worcestershire. The establishment of the college, which is to be known as "Avoncroft," has been made possible through the generosity of Mr. George Cadbury, who has presented to the Trustees two houses, a bungalow and fourteen acres of fertile land at Offenham, on the River Avon, near Evesham.

The main purpose for which the school has been founded is that of providing education in the wider sense, and the curriculum is not limited to technical instruction of the type provided by the existing Farm Institutes established under the scheme of

ıe Ministry of Agriculture. The new college is closely allied ·ith "Fircroft," a residential college for workers at Bourneille, Birmingham, founded in 1909. This college has succeeded ı developing personality to a remarkable degree in the course f three or even two terms of study along broad humane lines. Avoncroft" is primarily intended to extend the same opporınity to the rural worker.

The college course, which will consist of two terms of about leven weeks each extending from October to March, with a short acation at Christmas, seeks to give the student a broad, general utline of modern history, literature, economics, sociology nd thought, with particular reference to rural conditions nd rural applications. Practical instruction will also be given ·ith the object of introducing the student to the most modern ıethods of small farming, together with the various sciences pon which they are grounded. A library of text books and eference books is being provided, so that the students may have ıe opportunity of becoming acquainted with books of the type ·hich will be of use to them in their after life. Instruction ·ill be given in carpentry and the care of agricultural machinery, nd certain home industries, such as basket-making and hurdleıaking, may also be taught.

Visits will be paid to research and demonstration stations, with ıe object of widening the interest of the students and bringing ıem into contact with those whose business it is to investigate gricultural problems and furnish advice. Ultimately it may be ossible to arrange for tours to other parts of the British Isles nd abroad for the study of special agricultural conditions. The ocial life of the students will also be provided for; a workshop nd gymnasium have been constructed and provision is made for ames.

The proposed curriculum includes English language and literaıre, history and economics with special reference to agriculture, gricultural sciences, farm accounts and costings, agricultural ganisation, practical work in workshops and forge, and six ours a week farm practice and gardening.

Mr. F. M. H. Holman, M.A., has been appointed warden and ill lecture on cultural subjects. He will be assisted by lecturers ith practical experience.

Residential accommodation will be provided for from twelve ı fifteen students (16 to 18 years of age) and the fee covering esidence, board and tuition will be £20 for one term or £36 for vo consecutive terms.

Several bursaries have already been offered towards the fees of students staying two terms, and these will be awarded by the Committee to suitable applicants in cases of special merit.

The Warden, Avoncroft, Offenham, near Evesham, will be glad to answer inquiries and to arrange for interviews with any who are specially interested in the scheme.

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The Wild Onion.

As the Wild Onion (*Allium vineale*, L.) is troublesome on a field at the University Farm, Cambridge, it has been decided to lay down some experiments in the hope of arriving at an economic method of eliminating this troublesome weed on heavy clay.

The importance of gaining the benefit of farmers' experience and observation before designing the experiment is fully recognised. Amongst the suggestions which have already been collected are the following points:—

(1) Drainage.
(2) Heavy manuring with dung.
(3) A succession of fallow crops.
(4) A succession of spring planted crops.
(5) Bare fallowing commencing by autumn ploughing.
(6) Tillage during frost.

If any reader of this note can suggest other methods which he believes to be successful in dealing with this weed, Mr. A. Amos, Director, University Farm, Huntingdon Road, Cambridge, will be glad to hear from him, with the object of incorporating suggestions in the experiments.

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British Delegation to the Warsaw Congress.

A SHORT programme of the International Congress at Warsaw in June, 1925, appeared in this *Journal*, May, 1925, p. 189. A delegation from this country attended the Congress, and consisted of Sir Daniel Hall, Chief Scientific Adviser to the Ministry of Agriculture, Mr. Dan Crawford and Mr. E. W. Langford (National Farmers' Union), Mr. Alfred Wood (British Sugar Beet Growers' Association), and Col. Meysey Thompson.

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AGRICULTURAL RESEARCH IN RELATION TO THE COMMUNITY.*

Sir Daniel Hall, K.C.B., LL.D., F.R.S.,

Chief Scientific Adviser to the Ministry of Agriculture and Fisheries.

It is a common reproach that agriculturists have not made the same use of science as have those engaged in the other great industries—that farming is still a rule-of-thumb process carried out by methods which have their origin in the dark backward and abyss of time. In some respects this is indeed true. One has only to read Cato or Columella to realise that the Italian peasant of to-day is working and living in very much the same way as his Roman forbears, and even the more highly organised farming of Great Britain or Denmark or Holland is carrying on many of the essential operations of cultivation on lines that were laid down by the first great civilisers—the Romans. It is easy in fact to trace modern agriculture to a Roman ancestry; in Britain, for example, by the transplantation from the fifteenth century onwards of the traditions and practices that persisted through the Dark Ages in the Low Countries.

None the less progress has taken place and scientific development is going on. Under mediæval systems of agriculture the yield from England's land was of the order of six to eight bushels of wheat to the acre. The enclosure of common lands, the introduction of a recuperative clover crop into the rotation and of forage crops like turnips for the winter feeding of cattle and the making of farmyard manure, the return to Roman methods, in fact, raised the level of production to about twenty bushels of wheat per acre. This was about the average when agricultural science dawned nearly a hundred years ago—say about 1840, when Liebig exposed his theory of plant nutrition and Lawes began his experiments at Rothamsted. Growing scientific knowledge and the introduction of fertilisers raised the level of English production by 50 per cent. during the next generation, so that by 1870 the average yield of wheat per acre in England had become thirty-two bushels. At that level it has more or less remained down to the present day because a new factor then came into play, the importation of cheap wheat through the opening up of the Middle West of the United States, and of Argentina and Australia. The economic factors

* An address delivered before the Graduate School of the U.S. Department of Agriculture, 26th January, 1925. Reproduced from *Science*, 17th April, 1925.

of gold scarcity and rising costs of labour co-operated to limit the profit attached to high farming: the English farmer had to cheapen his production and lower his standard so that he only obtains the same yield to-day, though the acreage under wheat has shrunk on to the better land. Latterly we have seen the yield creeping up a little through the introduction of heavier cropping wheats—the products of scientific research.

In other directions there has been progress. The introduction of the self-binder alone has meant great economies in man power. I estimate that by the use of machinery in one way or another English farming, with an equal or greater output, employs some 25 per cent. less labour than it did fifty years ago. Cattle feeding is more economic. Breeding for early maturity, better adjustment of rations either for meat or milk production, have all tended to a cheaper output. There is still an immense margin for improvement. From scientific experiments one may calculate with some degree of confidence how much meat and milk a given quantity of fodder of one kind or another ought to yield. Yet when in the dark days of the war we took stock of our resources of cattle food, because tonnage could no longer be spared for aught but human food, soldiers or munitions, it was estimated that in the five years before the war the farmers of the United Kingdom at large only realised one-third of the meat and milk that was theoretically possible from the fodder that had been then available.

Disease amongst animals is another field in which research has not been idle; enormous savings have been effected in the average efficiency of our flocks and herds. Yet last year Great Britain had to pay a bill of approximately $20,000,000 to stamp out foot-and-mouth disease, and this was compensation only for slaughtered animals and took no account of the losses the farmers endured by the break-up of their businesses.

Great are the achievements and still greater the possibilities of agricultural research, but we must recognise that there are limitations to the effect of science upon agriculture which do not hold for the other industries. In the first place, in agriculture we are dealing with a living organism and the amount of control that we have obtained over plant or animal, over that stubborn essence we call life, is far less than we can exercise over inanimate nature, over iron or cement, over even the ether or the atom. When we attack vital problems we find that we cannot speed up processes or enlarge the unit in the way we can deal with the dynamo or spinning frame. It

still takes the wheat plant six or nine months to develop, and cows bring forth their calves neither more quickly nor more numerously for us than they did for Abraham. We see no way of growing three or four crops a year under temperate climatic conditions. The organisms we are dealing with will go through their cycle and you cannot hurry them. When you start hustling you find you let in secondary troubles of all sorts.

These limitations lie in the nature of things, and though on looking back we can count up the immense advances that agriculture owes to the application of knowledge we must not hope for sudden developments or revolutionary changes such as have been seen in flying or wireless telegraphy. In fact, for the time being I am bound to say that agriculture is actually suffering from the rapid developments and scientific achievements that have distinguished other industries. I say this advisedly and most solemnly. Agriculture is the fundamental industry, because we must all be fed, and yet you cannot point to any part of the world where agricultural wealth is being turned out and find the producers in a flourishing condition.

The rewards in agriculture, whether to the capitalist entrepreneur or to the labouring man, are not commensurate with those obtainable in industry or commerce, and so men are being drawn away to the towns and capital is being diverted from the farms. The movement is one common to all civilised countries, its sources are social as well as economic. The lure of the town has been secular, but modern facilities of communication and transport have given it a range of action hitherto unknown; yet it cannot go on for ever, for the world must be fed. One must interpret the steady rise of food prices which has marked this century, a rise now being resumed after the excessive fluctuations caused by the war, as evidence that we are approaching a limitation to the development of the towns because there is not food enough to go round.

The old economists would see a simple solution to this impasse; prices of food have only to rise sufficiently and men will be attracted back to the land in order to secure the profits it promises—the balance will be restored. But, looking back historically, has this ever happened? I can find no example of an urban population migrating into the country. If the countryside does replenish itself in men it is by breeding and by finding space in the country for the country bred. The

great increase in the food supplies of the world the last half century has witnessed has been due to the new countries becoming accessible, whereby opportunities were given to the rural population to put their sons on new land. But that process is nearly at an end, there are no longer the great vacant areas waiting for men.

Are we not to look for progress in another direction; can we not so intensify the farming of our existing land by taking advantage of science, machinery and organisation that agricultural production will become an industry capable of competing against other industries for men and capital? It was by a process of this sort, by enclosing the common lands and building up small capitalist businesses, that Britain succeeded a century and a half ago in meeting the needs of a population which was then beginning to expand as the industrial age approached. Our businesses have remained small, too small to be efficient to-day perhaps, and I can point to few examples of large scale industrial farming in successful operation.

In fact, though I pin my faith to big business on the land as necessary to the future production of food in order to meet the growth of cities, I am bound to say that the current seems sweeping in the other direction. Agricultural businesses, such as we have, find it difficult to pay the wages that will retain men on the land, with all its disadvantages of quietness and lack of amusement. Social and economic motives in our country are working towards the break-up of farming businesses into single-man or rather family farms, and similar forces have been even more powerfully at work in Continental countries in dividing up the land. The desire of men for independence, the determination to call no man master, the innate feeling among country folk that a man has a right to a bit of land of his own as he has a right to vote or to a soul of his own, makes in many countries the single-man holding a burning political question. And the man is ready to pay—to pay in labour, in days that endure from dawn to dark, in days that include the hours of his wife and children, in toil as against the regular pace of a factory, for the privilege of being a landowner.

But I doubt whether the process is fundamentally economic. Farming may become immediately more intensive when a great estate is cut up into small holdings, but the community so created becomes an unprogressive one, little fitted to take advantage of modern science, modern machinery, modern organisation. It is fundamentally uneconomic because it is

employing more men than are necessary to produce the food on which the community can be supported. I conceive it to be possible for 15 per cent. of the working population to be able to produce the necessary food for the rest of the nation, and the larger the margin that remains after this prime task has been performed of men who can be making boots and clothes, houses and motor cars, the greater the divisible wealth of the community.

But the only hope I can see at present for large-scale production, for organized industry on the land, lies in the advances that science can make. It is research alone that will enable the big agricultural business to compete with the excessive labour of the one-man farm, to pay wages and give conditions of life to its workmen equal to those prevailing in the urban industries. It becomes then a matter of the first import to the growth of civilization itself, not merely to agriculture, that agricultural research should be encouraged.

We may consider research from two points of view. In the first place, it is an intellectual affair carried out by the individual in response to the insatiable curiosity of the mind about its surroundings and its own existence. As such, it proceeds from an artistic impulse, it is not under control and it is not amenable to considerations of utility. Just as some men must write poems or paint or make music, as other men find themselves compelled to speculate, to become philosophers or metaphysicians, so similarly the class of men we are considering must investigate nature. The passion to do this is part of the man's make-up and cannot be created by any act of will on his part. I may remind you of the story of the old school-fellow who met Dr. Johnson at the height of his fame. "Doctor," he said, "I have often tried to become a philosopher myself, but cheerfulness will keep breaking in." And as a man cannot deny himself a desire to investigate, so he is not drawn to investigation by any ulterior motive.

I may take an illustration in the science of astronomy. Historically the study of the stars would appear to have had its beginnings in the search for useful knowledge. In the early civilisation of Egypt it was necessary to find out a means of determining exactly the length of the year and the recurrence of the seasons. Later on the delusive promises of astrology led to further observation, and as we know, the first organised observatories were built for the service of the sailor for the drawing up of what we call a nautical almanac. But these prime necessi-

ties were easily satisfied and the real science of astronomy cannot for the last hundred years have served any useful purpose to any man. None the less, the development of the science and the foundation of observatories has proceeded at a greater pace than ever before, purely in response to the universal feeling of curiosity. Oddly enough, this kind of knowledge has proved itself singularly attractive to the American millionaire, who has latterly been the great founder of observatories. Indeed the uselessness of astronomy is to many people one of its great attractions. A great astronomer once said to me, " One advantage I enjoy is that my science cannot make money for anybody. At least no merchant traffics in my heart." We may parallel this feeling with the remark of some noble lord who was being congratulated on his elevation to the Garter, " The best of the Garter is that it implies no damned nonsense about merit."

Research again possesses this quality in common with what are usually called the arts—its characteristic mental process is intuition. When we were students we used to be told that the two processes of thought by which science proceeded were deduction and induction. It was pointed out that the barrenness of the mediæval schoolmen was due to the fact that they worked by deduction alone from imperfect premises. Bacon became the father of modern science by recalling it to induction and to the painful collection of facts. Bacon's apothegm was recalled, " Hypotheses non fingo," and it was suggested that the method of science was to collect an assemblage of facts and put them into some kind of sorting machine, whereupon a theory will emerge. However, a little examination of the actual history of discovery soon shows that it does not proceed in such a fashion. The function of facts is to provide tests for your hypotheses, but you cannot begin to collect the facts unless you have a preliminary hypothesis.

Let me take an example in the science of meteorology. For generations people made observations of the weather, set down the records of temperature, rainfall, barometric height and so forth. Nothing whatever came of these facts until in the study one or two workers evolved from their own consciousness the theory of the cyclone. Induction in fact failed. Bacon's other great catchword, " Experimentum crucis," showed that he really had a better appreciation of the true processes of science, and the really beneficial influence he exerted upon the early science of the seventeenth century was that he directed men's attention to

experiment and to the mechanic arts as the sources of knowledge. To come back to our text, neither induction nor deduction complete the story of the mental processes by which investigation proceeds. We now realize a third category in the shape of intuition, the power of seizing the truth by a sudden flash of illumination. Indeed, the great discoverer may be a man in whom what is commonly called the scientific habit of mind is imperfectly developed. He may not be severely logical, methodical in his arrangement of facts, meticulous in accepting deductions.

As a recent example we may instance the late Sir William Crookes, whose marvellous discoveries certainly did not proceed by a process of minute but steady accretions from known foundations. By a sudden jump of mind he invented the radiometer, regarding which his explanations were mistaken, but his intuition led him from this point on to the whole gamut of high vacuum discovery which has resulted in such developments as the Röntgen rays, the elucidation of the structure of the atom, wireless telephony, etc. Sir William Ramsay provides another instance. In the eighteenth century Cavendish had noted that after removing all the oxygen and nitrogen from air a small residuum was left uncombined. In true scientific spirit he puts this down to the inevitable errors of the experiment. But working on the same track and worrying over the discrepancy between the atomic weights of nitrogen from different sources, Ramsay's intuition led him on to the discovery of argon and the range of new light elements.

So far I have only been considering research from its intellectual side as a response to man's curiosity, but the nineteenth century proved it had also a practical side inasmuch as it led to an enormously increased control over the forces of nature. I need not sing the praises of what has been effected by steam, by electricity, by modern medicine; willy nilly the results are being incorporated into our daily life. Research leads to efficiency, and efficiency is a means of making money. The modern State must cultivate research if it is to become efficient and survive in the world's competition; hence all are agreed now on the endowment of research, and since in farming there are no great business corporations, agricultural research must for many years to come be maintained by the State.

If, then, research is to become of such importance to the State, it behoves us to ensure conditions for the research worker under which discoveries are likely to be produced. To do this

properly we must understand the psychology of the investigator. If it is true that research, like art, grows by a process of intuition, we can no more organize it into existence than we can organize the output of poetry. Nor are we likely to obtain it by a system of prizes, of rewards, commensurate to those obtained in the great professions, in industry or commerce. What we can do is to contrive sheltered places in our community in which research workers can live. We cannot guarantee results, but we may wait in faith because, as we have said, the impulse to make discoveries is fundamental in man's mind. Now the sheltered places in which the research worker can live are the universities.

One last word, the State must have research in order to obtain efficiency, but does mankind really care about efficiency? At bottom man does not, he wants to " loaf and possess his soul." Efficiency is a beautiful word, but efficiency to what end? If pursued for its own sake it may become a curse. Many people have vivid recollections of the sufferings they endured under a really efficient parent in an efficient household. I, myself, am officially engaged in promoting efficiency, in bringing up the efficient farmer and in insuring the efficient use of the land. But I cannot help having a great deal of sympathy with the old-fashioned farmer, who is content with what the land brings him, who is making his living but not worrying overmuch about making money. He is often inefficient, but again he is often a very worthy human being.

To take another illustration, I have a vivid recollection years ago of a little piece of swampy meadow, half encircled by a brook, which after other wanderings found its way into the Thames. There was a patch of reeds and willows, an old salley garden, where the reed warbler swung her nest and flitted through the tangled herbage. The wet meadow itself was starred over in August with Grass of Parnassus. It was indeed one of the most southern holds of that flower of the cool northern hillsides. Well, the efficient man came along, saw his opportunity, grubbed up the willows and laid out the meadow in watercress beds. He is a benefactor of his kind and has caused millions of blades of an edible kind to grow where there was none before; but I have a sore spot in my heart for the vanished warblers and the lost Grass of Parnassus. I fear, however, that the pursuit of efficiency is one of those contradictory elements in man's make-up that won't let him rest, that is always urging him against his will towards further attainment. What a dreary prospect if it only results in adding an ever greater and greater popula-

tion to a world always working harder and harder! Is there any way out of this impasse? I can only again suggest the kindly force of that other element in the texture of men's minds, the passion for artistic expression. The winds of beauty come and go, but as they rustle through the tree of life, among the dropping leaves that are ourselves, men will cease from their toil to listen and pause to retell in song or story, in paint or stone, the message they bring.

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MOLE DRAINING BY DIRECT HAULAGE.

THOMPSON CLOSE,
Ministry of Agriculture and Fisheries.

No season has shown so clearly as the last winter, with its continuous heavy rainfall, how many acres of land needs attention to be given to field drainage. Whatever may be our view of the best method to employ, it is quite certain that for all practical purposes we must rule out tile-draining (or pipe-draining) as being impossibly expensive, since the cost to-day would in many cases amount to nearly as much as the land is worth. There are various other methods which it is possible to employ, but they entail trenching, and, even if the cost of tiles is saved, as may be the case with bush-draining, the expense of the trench alone is, broadly speaking, prohibitive. The one remaining method which is available to the heavy-land farmer is mole draining.

It should be stated at the outset that it is useless contemplating the employment of this method unless there is a clay subsoil, but since most of the land needing under-draining is land with a clay soil, there are few cases where this method is not effective. In other cases the trouble may be traced to defective outfalls, or a pan : and in either case the remedy must be sought in other directions.

Mole draining is by no means a new idea. The new factor which has created fresh interest in the system is the introduction of the tractor-drawn machine. Mole draining has been, for many years, performed by horses, and by steam-cable sets. There may still be seen at work examples of the old capstan horse gear, and though the process is excessively slow, the results are excellent. There are still lying about on farms other old ploughs intended to be drawn direct by 8 or 10 horses, but this system is both expensive and unsatisfactory, since it is very difficult to get a team of more than 3 or 4 horses to pull in unison.

The steam-cable system has been employed for many years and has drained a great many acres with excellent results, but it is not always available, as, for example, in some parts of the west of England, while, however excellent the work performed, it costs more than most farmers care to pay. This is almost inevitable, since two engines and four or five men are considered necessary.

The cost of mole draining depends upon three factors: the diameter of the mole, the depth of the mole and (when reckoned by the acre) the distance between each drain. The draught of the plough obviously increases with the size of the drain—a $2\frac{1}{2}$ in. mole requires much less power than a $3\frac{1}{2}$ in. mole, probably about half. Similarly, every inch in depth greatly increases the resistance, and consequently the power required. As the distance between each drain is increased so the cost of draining a field is reduced, and it is the practice of farmers when employing steam tackle not to require the drains to be close together. In this way the cost per acre may be kept at a comparatively low figure, but the draining may be relatively inefficient.

If we had sufficient knowledge of the laws governing the percolation of water through the soil and subsoil, we could probably work out fairly exactly a formula which would show how to produce a given effect (in this case, drawing off the surface water) by varying the diameter, depth and width of the moles. We have not this precise knowledge, but we know, as the result of trial, that a number of small moles comparatively shallow but close together will drain a field more effectively than a smaller number of larger and deeper moles. Incidentally it may be mentioned that, apart from draining the land, the disturbance of turf in the process of drawing moles undoubtedly improves grassland; and when mole drains are close together the turf of the whole field is effectively dealt with.

At this point we must introduce another factor which has a bearing on the relative efficiency of the system. Many of the older moles with a bore of 3 to $3\frac{1}{2}$ in. diameter have lasted for 30 or 40 years. When spread over so long a time the actual cost is very much reduced: and it might well be argued that, if moles of large bore at a considerable depth have lasted so long, we should be very cautious in adopting a newer system, however cheap it may be. It is, of course, true that if mole drains are made too shallow the soil in which they are drawn may not be solid clay, and hence the moles will not stand, or,

FIG. 1.—Capstan Horse Gear.

FIG. 2.—Capstan Horse Gear. View of Mole.

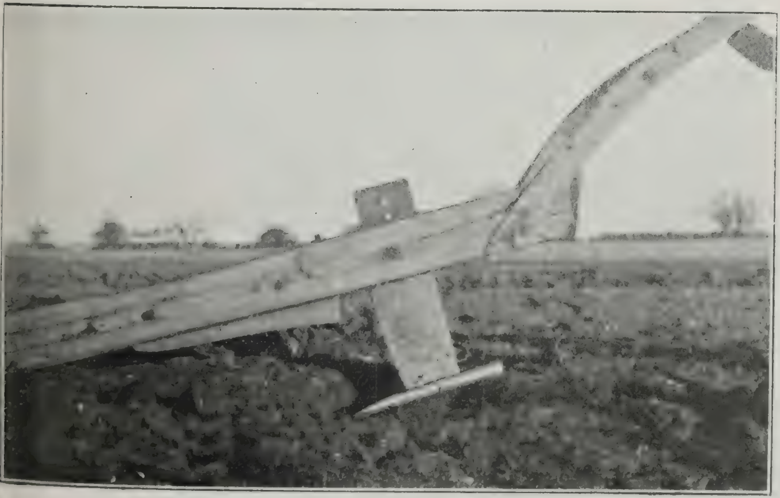

FIG. 3.—Direct Horse-drawn Mole-plough.

Fig. 5.—Wells Mole-plough: in action.

Photo by "Agricultural Gazette."

Fig. 6.—Wells Mole-plough (lighter type): cartridge entering ground.

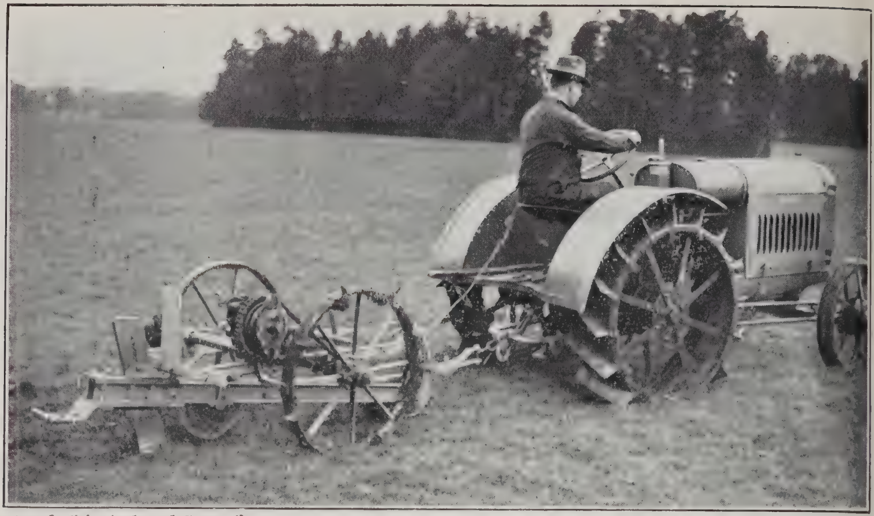

Photo by "Agricultural Gazette."

Fig. 7.—Martin Mole-plough : entering ground.

Photo by "Agricultural Gazette."

Fig. 8.—Martin Mole-plough : rear view.

even if it is clay, pressure from above may crush them. By practical experience, however, it has been found that moles made at 16 in. or 18 in. depth are perfectly formed and from their appearance show every sign of lasting.

Tractor Mole Ploughs.—The first effective tractor mole plough was introduced by Messrs. F. B. Wells and Sons of Welwyn. The head of the firm had had a lifetime's experience of steam-cable work, and the tractor-mole plough was designed to meet the normal conditions of farming practice. The implement consists of a main frame to which the coulter and a cartridge with a $2\frac{1}{2}$ in. bore are attached: two floating wheels carry the beam when thrown out of operation: when at work the beam rests on two skids fixed at either end. A disc coulter cuts the turf in advance of the main coulter. A hand-lever enables the cartridge to enter the ground automatically at an angle and to be pulled horizontal as the tractor proceeds: this obviates the necessity for digging entrance holes for the cartridge as with the earlier types of horse and steam-mole ploughs; when the end of the drain is reached a spring catch is released and the cartridge automatically rises to the surface. The implement is made in several sizes and the lightest machine has a 2 in. bore.

Machines of similar type have been introduced by other firms, notably by Messrs. Martin and Sons of Stamford. The implement made by this firm is rather more elaborate and is fitted with a self-lifting device, which enables it to be operated by the tractor-driver. To enable this machine to be operated by the lighter type of tractor such as the Austin or Fordson, a furrow is first drawn: a sliding plate, attached to the rear of machine, is let down to the bottom of the furrow and the mole is drawn at, say, a foot below the plough sole but 18 in. below the surface of the field.

The type of tractor required depends upon the draught of the mole-plough, which as already stated varies with the size of the cartridge and the depth of the drain. It is useless to have a tractor which by reason of its small power cannot cope with the task. It is equally important that the travelling wheels shall be fitted with strakes or, preferably, spuds, which will grip the ground without digging in. If a tractor of sufficient power is provided and attention is given to the adhesion of the wheels, the work can be done speedily, efficiently and cheaply. About 800 chains of drain can be made in a day of 10 hours, using not more than 10 gallons of fuel.

Connection with Main Drains.—In laying out the drains each field must be considered individually: regard must be had to its fall, to the position of the outfalls, and to the existence of ridge-and-furrow. The cheapest method where the field is level and falls into an open ditch, is to back the mole-plough into the ditch and work up to the top of the field: the only additional cost is involved in inserting a 2 in. pipe at the end of each mole on the ditch bank to prevent closing up by the treading of cattle. Where the ground is not level or there is no open ditch main drains or grips must be cut on the lines corresponding as closely as possible to the natural drainage of the field and the moles led into them either herring-bone fashion or in parallel. The main drains should be cut after the moles have been made, otherwise the tractor passing over causes the walls of the trench to cave in.

The main drains should, if possible, be piped: if this cannot be done, on the score of expense, brushwood or clinker may be used with good results, which will continue for many years. Even where pipes are used, a layer of clinker or brushwood should be placed on top. If this is done and the main drain kept free, moles can, if necessary, be re-drawn at an interval of years without disturbing the main drain. The cost of making main drains depends upon so many factors that no precise figures can be given: it is, however, a comparatively simple matter for a farmer to work out the probable cost in any given circumstances.

A number of mechanical devices are available for cutting main drains. The Revolt Excavator is the cheapest, and in expert hands under suitable soil conditions will make an excellent job. A detailed description of this, and of other excavating machines, has already appeared in this *Journal* (February, 1920).

Mole draining should be performed between the months of October and May, since the wetter the ground the easier the work: but it must be remembered that when water stands upon the ground, wheel adhesion is likely to be seriously affected.

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Photo by "Agricultural Gazette."

Fig. 9.—Revolt Excavator: first cut.

THE REVIVAL OF FLAX GROWING IN ENGLAND.

FLAX is one of the oldest cultivated crops in the country. In the middle ages there were very few districts in which flax was not grown, and subsequently manufactured into linen to meet local requirements. Flax continued to be so grown until the eighteenth century, and although the home manufacture of linen gradually decayed, largely because of the introduction of cheap calico, the crop was still widely, though not extensively, cultivated throughout the first half of the nineteenth century. Then the cutting off of the greater part of the supplies of raw cotton as a result of the American Civil War stimulated the production of flax. The fibre, of course, was no longer required for home consumption, but to meet the factory demand. The area under flax gradually increased in Great Britain until it reached a total of about 24,000 acres in 1870. In that year 7,000 acres were grown in Yorkshire, nearly 3,000 in each of the counties of Lincoln and Suffolk, 1,800 in Norfolk, 1,200 acres in Cambridge, 1,100 acres in Somerset and 830 in Dorset. In Scotland 600 acres were grown in the two counties of Fife and Stirling and 400 acres in Ayr and Lanark. A large proportion of this area was grown for linseed, but not less than half was probably grown for fibre. After 1870 the decline in the cultivation of flax was rapid. In 1871 it had fallen to a little over 17,000 acres, in 1881 to 6,500 acres, in 1891 to less than 2,000 acres, in 1901 600 acres, and in 1911 it was less than 500 acres.

Assistance of the Development Commission.—In 1911 Dr. J. V. Eyre was appointed by the Development Commissioners to report upon the possibility, both from the scientific and practical point of view, of reviving the flax and hemp industries in Great Britain. Dr. Eyre examined the methods followed in all the chief flax-producing countries of Europe, and in his report he came to the conclusion that no difficulty was to be apprehended in raising good crops of flax in Great Britain, but that the management of the fibre processes, especially those of retting and scutching, could not be worked well into the routine of farm operations. It was recommended, therefore, that the possibility of centralising the processes of fibre separation, while leaving to the farmer the task of growing the crop, should be put to the practical test, and that two experimental factories should be established in suitable districts.

It is, of course, obvious from the figures mentioned that, unless the farmer has the stimulus of very high prices, he will not undertake the cultivation of a difficult crop which involves the manufacture of fibre. The point to be determined, therefore, was whether, when the obligation to manufacture the fibre was removed, the farmer would take kindly to this crop, which, from a broad standpoint, seemed a valuable one to the agriculturist and one that should lead to the establishment of rural industries and give rise to considerable local employment.

Experimental Work.—Dr. Eyre's recommendations were favoured with the approval of the Development Commissioners, and early in 1913 the British Flax and Hemp Growers' Society was formed under the Industrial and Provident Societies Act, 1893, to carry out the proposals that had been made. The University of Leeds provided technical assistance for the work in Yorkshire. In the same year experimental stations were established at Yeovil and at Selby and continued to be operated until the winter of 1917-18. During that period the acreage of flax grown and handled under the scheme increased from about 100 to 500 acres. The work of these five years showed definitely that a better strain of flax than that commercially available was required, since a crop yielding a better return to the farmer and a better fibre to the user would provide a much needed stimulus to the industry. A further point which emerged was that greater knowledge of the retting process was highly desirable in order that it could be efficiently controlled. Work was done upon both problems, as well as on that of the manurial dressings of the crop. The most important result was the production of strains of improved seed which held out promise of heavier and better crops in the future.

Flax Growing during the War Period.—The necessities of war cut right across this development work. The cessation of supplies from Europe gave rise to a demand for 10,000 acres of flax to be sown in England, primarily to provide seed for sowing in Ireland, but also to provide additional fibre for the manufacture of aeroplane cloth. The small experimental scheme was wound up, and the flax-growing industry entered on a period of war-time expansion and post-war collapse. The story is generally familiar. At the time of the Armistice in November, 1918, a Flax Production Branch of the Ministry of Agriculture, set up to organise flax growing, owned or had contracts for straw representing close upon £500,000. In view of the high prices ruling for flax products it seemed likely that the industry might

establish itself on the comparatively large scale to which it had then grown and that it should be possible to dispose of the factories as going concerns. But when in 1920 the various Government factories were passing or had passed into private ownership a heavy slump in the linen trade made it impossible to conduct them at a profit. As a result only two factories are now operating, one in Yorkshire and one at Bunford, near Yeovil. Meanwhile, the production of flax had increased to 18.000 acres in 1918 and 1919, and 22,000 acres in 1920. Nearly 6,000 acres were still under flax in 1924, but the greater part was being grown for seed and not for the fibre.

Imports and Home Supplies.—This country is very nearly concerned with the production of flax. In the ten years before the war the total imports into the United Kingdom of flax varied from 62.000 to 87,000 tons a year. The imports of tow varied from 15.000 to 20,000 tons. In 1922 31,000 tons of flax and 8.500 tons of tow were imported. Home supplies of flax are derived almost wholly from Ireland. Before the war they amounted to 10,000 tons and upwards to 15,000 tons of flax and tow annually. In 1921 the Irish production fell to about 4,300 tons, but by 1923 it had again increased to about 8.500 tons. At the present time foreign supplies are extremely uncertain, and the textile machinery in this country is half idle. At the same time it is quite possible to grow excellent crops in this country as well as in some parts of the Empire overseas.

A New Strain of Flax.—A further important consideration is that a new strain of flax of much promise has been evolved. The need for conserving and bulking the seed of this new strain, which is known as J.W.S., led to arrangements being made between the Linen Industry Research Association, the Imperial Government and the Government of Northern Ireland, by which the factories at Bunford and Lopen in the Yeovil district were taken over by the Association last year for the specific purpose of bulking the seed. Since then a strong Committee of the Board of Trade, under the Chairmanship of Sir Frank Warner, has been considering what steps can be taken to bring about the growing of flax seed and flax in the United Kingdom on a commercial scale.

In an Interim Report* dealing with the matters of most urgent importance, the Committee has reported that the growth of flax seed and flax on a commercial scale is dependent upon the development of new strains of pedigree seed. The position

* Board of Trade: Committee on Flax Seed and Flax Growing in the United Kingdom. Interim Report: Flax Seed. 1925, Price 6d. net.

is complicated by the fact that the Irish flax grower has not made a practice of saving seed from his crop. The climate of Ireland is not favourable to the ripening of seed, and the method of treatment there adopted has called for the pulling of the flax before the seed is ripe, and immediate retting without the recovery of such seed as has been produced. Consequently the Irish grower has been dependent upon seed imported from Holland and other continental sources.

On the other hand, seed can be grown and recovered in Somerset (as in other parts of Great Britain), and it is here that factory facilities are available which would enable the farmers to grow flax, while at the same time providing for retting to be centralised.

The Committee in effect recommends a return to the policy pursued before and in the early years of the war. In view of the prejudice created by the failure of the companies which took over the Government factories from the Flax Production Branch, there is no prospect of this work being undertaken in the ordinary way of business, and the Committee therefore recommends special Government assistance. It proposes that the two factories at Bunford and Lopen should be taken over by an appropriate body and contracts made with farmers for the production of seed and fibre. In the view of the Committee it should be possible for these factories to be working at their full capacity in 1926; after which seed should be available for sale in Northern Ireland, Scotland, the Dominions and Colonies. The seed, after being placed on the market, would be multiplied further by private enterprise; but the Committee thinks it essential that the factories should be retained permanently as a source of supply of mother seed, thus maintaining a continual supply of pedigree seed for distribution.

The Government have adopted generally the recommendations of the Committee, and without binding themselves to continuing in the business for more than a brief period of years, have arranged for the acquisition of the two factories and for the constitution of a Society, not trading for profit, under the Industrial and Provident Societies Act, 1893. Contracts for growing flax have already been made with farmers; there has been no break with the activities of the Linen Industry Research Association; and the work is developing in the way forecast by the Committee.

It is too early yet to say what success will attend the efforts of the Flax Industry Development Society. It is composed

principally of business men who are anxious and determined to make a commercial success of the venture. The Government, for its part, expects to recover the money invested and, when the time is ripe, to place the business on an ordinary commercial basis. Should anticipations be realised, we should see established in England a seed-growing business supplying flax seed of a quality never hitherto put on the market, and a great extension of the area of flax grown for fibre in all parts of the British Isles and in other parts of the Empire. At the same time the British linen industry would have an assured supply of superior fibre which should place it on a permanent basis of prosperity.

In this enterprise there are associated the Imperial Government and the Government of Northern Ireland, manufacturers and growers. The Linen Industry Research Association is intimately concerned with what is essentially a development of its own work, and the new Society will work in close relation with the older body. The work of the Society should not, therefore, fail for lack of technical guidance.

What it is essential to understand is, that the scheme is primarily one for supplying seed of superior quality and thereby providing the basis for the development of an existing industry. It is not a project for large scale manufacturing and trading. Obviously the success of the scheme depends upon the continued demand for fibre of high quality—of which there should be no doubt—and to no less a degree upon the willingness of the farmer to grow flax. This he undoubtedly will do if the price is right, and if a solution is found for the problem of relieving him of the fibre processes. The present scheme aims at ensuring a fibre of high quality and, therefore, of ready demand at a good price, and it provides facilities for retting and scutching flax locally grown. A system such as this holds out the best promise for reviving flax-growing in this country.

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AGRICULTURAL COSTINGS IN SWITZERLAND AND DENMARK.

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I.—SWITZERLAND.

IN 1924, the writer was granted a Travelling Research Fellowship by the Ministry of Agriculture and Fisheries for the purpose of studying agricultural co-operation and costings in Switzerland and Denmark. In this article, a summary is given of some of his impressions of the costing work in Switzerland. Denmark will be dealt with in Part II.

While in the work of Dr. Laur and his capable assistants at Brugg there is much to admire and much to imitate, one could not help feeling that in some respects at all events they might learn from us. In England, in Yorkshire at all events, the system of agricultural costings adopted has been built up on *service to the individual farmer concerned*, and the results obtained from a careful study of the accounts have been utilised largely as an aid to farm management. If English workers have erred in emphasising, possibly too strongly, the practical and utilitarian side of farm accounts, there is no doubt that in Switzerland and, to a less extent in Denmark, workers have erred in the other direction, and their point of view has been political and social rather than individualistic.

Realising that if a national agricultural policy were to be obtained in Switzerland, it was no use going to the Government or to the country with generalities, Dr. Ernest Laur, the well-known economist and secretary of the Union Paysans Suisses, has been engaged since 1901 in patiently, laboriously and systematically collecting and arranging statistical data taken from the carefully kept books of some four hundred farmers, whose accounts have been supervised through the Union.

The value of these trustworthy data has been inestimable, not only to the agricultural industry, but to the country as a whole, for on its evidence, and the lessons to be derived from it, a national agricultural policy has been built up, which has kept the land under the plough, made the growing of wheat still a paying proposition, safeguarded the agricultural industry, and made it possible for the producer of milk to obtain from 70 to 75 per cent. of the price paid by the consuming public.

The accounts of the farms supervised by Dr. Laur are kept on the " extensive " rather than the " intensive " system. The

book-keeping system adopted is made as simple as possible, but sufficiently accurate to provide reliable figures; no attempt is made to estimate the cost of production of each branch of the farm work, as this might necessitate too complicated a system of accountancy for the farmer who does his own book-keeping. Receipts and payments are entered in a detailed cash book, and records are made of all payments in kind made by the farm to the household, or of any such payments made by the farm to the staff. A detailed valuation is made at the beginning and end of the year. From the study of the records so obtained, a large amount of valuable information can be extracted, particularly if, with the object of framing a national agricultural policy, it is imperative to know exactly how the industry as a whole is standing.

Thus, the yearly variations in the labour bill, the total working expenses and gross and net returns when expressed on the basis of unit of area, and particularly the net returns when expressed as a percentage of capital invested, as determined by Dr. Laur form very interesting reading.

TABLE I.

Swiss Results on 6,057 Holdings.

Year	Labour Bill per acre			Gross Output per acre			Working Expenses per acre			Net Returns per acre			Net Returns as per cent. of capital invested	Total Capital per acre		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	per cent.	£	s.	d.
5 years 1901-5	4	12	5	9	18	6	7	8	3	2	10	4	3.13	80	8	6
7 ,, 1906-13	6	1	6	13	19	11	10	6	0	3	12	9	3.67	99	3	6
1914 - -	5	9	4	13	4	7	9	16	9	3	7	10	3.75	96	15	9
4 years 1915-18	7	7	6	22	4	6	12	7	5	9	17	1	9.84	100	2	2
1919 - -	11	13	2	28	12	0	19	15	6	8	16	6	7.94	111	0	0
1920 - -	12	9	0	27	17	6	21	4	2	6	13	4	5.58	119	16	3
1921 - -	11	18	7	22	17	8	22	10	11	0	6	9	0.31	108	0	0
1922 - -	10	10	7	19	2	5	20	18	6	–1	16	1	–1.61	104	12	6

During the War period both labour and other working costs increased considerably, labour costs reaching their maximum in 1920, and the total working costs in 1921. There was a sharp rise in prices in 1918, causing the net return to the producer to jump up to 15 per cent. on the capital invested. With an intimate knowledge of the agricultural conditions, it was an easy thing to adjust, fix and control prices on a reasonable and just basis, with the result that during the four War years, 1915-1918, the farmers' net returns averaged only 9.84 per cent., and there was no very great and abnormal rise in the cost of living. After the War, came the slump and the agricultural crisis; but a

crisis easily tided over. In 1922 there was a loss of 1.6 per cent. on the capital invested—our results in Yorkshire showed an average loss of 17.7 per cent. during that year, and a loss of more than one quarter of the farmers' capital in the two big years of the slump. In Switzerland there was no big inflation during the War, and in consequence no big deflation afterwards.

Possibly it may be urged that the "extensive" system of costings is of more value from the national than from the individual standpoint, but it certainly has its advantages, and while we in England would be very ill advised to cut down in any way the "intensive" system we have adopted, it certainly does seem to the writer to be desirable to undertake in addition a simpler "extensive" system, modified more or less on the methods of Dr. Laur.

Although Swiss records go back to 1901 and relate to some 6,000 holdings, only six farms, as far as the writer could see, are being at the present time completely costed. While, therefore, the position of the industry as a whole is known, very little detailed information is available as to the costs of production of the various farm crops and produce, still less as to the factors which influence the varying costs of production on different farms.

The farms can be and are classified according to the different systems of farming adopted and according to the size of the holding, so that information is readily available as to how far the size of the holding is a factor influencing its efficiency: and as to the type of farm which at the present time is giving the best financial return.

Switzerland is essentially a country of small holdings, more than 83 per cent. of the holdings being under 10 hectares, or 25 acres, and these holdings include 54 per cent. of the cultivated area of the country, if forests and pasturage are disregarded.

TABLE II.
Swiss Results.

Size of Holding	No. of Holdings	Capital Invested per acre			Output per acre			Production Costs per acre			Net Balance per acre			Balance expressed as Interest on Cap'tal invested	Normal Int. per acre on Capital invested per acre			Balance per acre afterallow ing for normal Interest o Capital		
		£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	per cent.	£	s.	d.	£	s.	d
7½ to 12½ acres	662	149	18	8	22	11	7	18	15	1	3	16	6	2.5	6	0	0	-2	3	
12½ to 25 acres	2 457	116	16	2	19	0	3	14	5	6	4	14	9	4.0	4	13	6	0	1	
25 to 37 acres	1 367	108	8	5	17	17	2	12	8	11	5	8	3	4.9	4	6	9	1	1	
37 to 75 acres	1 247	96	11	10	16	2	3	11	1	1	5	1	2	5.2	3	17	3	1	13	
Over 75 acres	364	75	4	3	13	17	7	9	11	10	4	5	9	5.6	3	0	2	1	5	

Dr. Laur's results show that in spite of the high gross output from the holdings under 12½ acres their high capitalisation and high labour and other production costs were instrumental in reducing the average net profits obtained on them to less than 3 per cent. on the capital outlay, as compared with more than 5½ per cent. on the holdings of more than 74 acres; from which it would appear that the efficiency of the normal holding increases with its size, certainly up to 75 acres. There is a very marked falling off in efficiency as the holding falls below 30 acres.

No one going over the average Swiss holding could fail to be struck with the size and equipment of the buildings, especially in comparison with the size of the farm. Nearly every farm is equipped with either a "bridge formation," so commonly met with in Scandinavia, or some form of elevator so as to avoid the labour of pitching. Every farm has its liquid manure tank and pump, and in a large number of cases pipes are laid on from the tank to the fields, and the liquid manure sprayed on to the meadow land by means of a force pump at the holding. In one case, from the holding down in the valley, liquid manure was being pumped on to the Alpine grazing land above. While the figures available make it difficult to see how far this heavy expenditure on buildings and equipment is justified by results, some idea of the way in which the farms are being handicapped by having to carry so large a proportion of dead stock, can be obtained from a study of one farm of about 35 acres, more than 30 of which were under grass.

TABLE III.
Capital.

Invested in	Total.	Per Acre.	Per cent.
	£	£ s. d.	
Land	1,692	48 0 0	34.0
Buildings	2,050	58 10 0	41.5
Implements and Machinery ...	452	13 0 0	9.5
Live Stock	650	14 10 0	10.0
Store and Floating Capital ...	250	7 0 0	5.0
Total	£5,094	£141 0 0	100.0

It will be seen that the farm was carrying in the form of unproductive capital (buildings, implements and machinery) a dead weight of more than £71 per acre, representing 51 per cent. of the total capital, and that the buildings, implements and machinery on the farm were approximately one and a half times the value of the land itself.

(To be concluded.)

LUPINS AND LIGHT LAND.

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IN this *Journal* for January, 1920, p. 982, a short account of the value of the lupin to the British farmer was given by the writer, this being a résumé of a paper read at the British Association in 1919. Since then much interest has been taken in the subject and enquiries have been dealt with from various parts of England, Scotland and New Zealand.

It was pointed out in the paper above mentioned that lupins are very valuable amongst cultivated plants in that they may be grown with the greatest ease on the poorest of light land, and that they greatly enrich such land in vegetable matter and nitrogen. At the present time the economic problems connected with the poor light land of this country are quite as urgent as they were in 1920. Large areas of such land are being abandoned as unprofitable for cultivation. Land of this type will not grow grass satisfactorily, except in districts of heavy rainfall—hence the problem is not one of arable versus grass, but of arable versus practically derelict land. Sandy soil which will grow fair crops if under a carefully thought out rotation of light land plants, will, if allowed to go down to grass, produce food worth only a few shillings an acre annually.

Continental Work upon Lupins.—Great interest is taken in lupin growing upon the Continent of Europe, especially in Germany and Holland. In the former country there exists an "Association for encouraging Lupin Cultivation," which has done much to call the attention of the agricultural community to the importance of lupin growing on light land. The valuable work done by Dr. Schultz, at Lupitz, in improving a poor sandy soil by means of lupins was referred to in this *Journal*, January, 1920.

Dr. Baessler, at Kummerow, found that ploughing in lupins more than doubled the crop of rye. In western Bohemia perennial lupins, when planted with forest trees have been found to benefit the growth of the trees greatly during the first ten years after planting.

At the Janikow starch factory in Pomerania experiments were conducted in 1920, with a view to discovering a satisfactory method of removing the poison from lupin grain, four processes being tried. In the report it is stated that lupins which have had the poison removed constitute an excellent food for man and beast.

At the pig feeding station at Ruhlsdorf, feeding experiments with pigs of all ages have been conducted with lupins. Yellow lupins were softened for 12 hours in hot water, in a special steamer, then steamed for 1 hour and afterwards washed for 24 hours in several changes of water. The resulting lupins, from which the poison had been extracted, were mixed with steamed potatoes and the cold mixture was given to the pigs, *ad lib.*, with very favourable results.

Experiments on the digestibility of several lupin products, after their bitterness had been removed, were conducted during 1920-21 at the Wurtemburg Agricultural Experiment Station at Hohenheim. The lupins had been rendered free of bitterness by Prof. Bergell's method, using common salt.

The conclusion was reached that lupin products, deprived of their bitter flavour, form an excellent protein feed, which can be easily kept for a long time, is very digestible both for ruminants and swine, and is almost equal to soy cake in favouring the secretion of milk. The writer is indebted to Mr. E. I. Robson, M.A., for pointing out to him the very numerous references to the value of lupins in classical literature. The writings of Pliny, Columella, Palladius, Theophrastus and others contain observations which show that the value of the lupin was thoroughly understood in ancient times.

Cultivation.—For those who have no previous experience of lupin growing the following brief notes may be of use :—

Lupins are very similar in cultural treatment to spring beans; they are, however, unsuited for growing on heavy land. The land is ploughed, cleaned if necessary, and the seed drilled at the rate of $1\frac{3}{4}$ to 2 bushels per acre. The rows may be the same distance apart as with spring beans. When grown for seed they are best sown on very poor light land, as under such conditions they ripen better than on good land, and they should, if possible, be sown in April. If sown in March there is danger from frost, while if sown in May the seed may not ripen very well. If sown for green manuring or for folding with sheep they may be sown any time up to the middle, or even the end of July.

Lupins may be horse-hoed, as with spring beans—often, however, this operation is omitted. In fact the land on which lupins are grown is so poor that usually the minimum of expense on tillage operations is incurred. The only further cultivation is to plough the crop in, or to plough the land after folding. Where the seed is harvested the crop is cut with

the binder or side delivery machine (the spiny pods of the lupins are hard on the binder canvases) and harvested exactly as spring beans.

The price of lupin seed, owing to the limited market, is subject to rather violent fluctuations. In February, 1925, growers were able to obtain from 5s. to 6s. a bushel for a useful sample. The yield varies from 20 to 30 bushels per acre, which is quite good considering the extremely poor land upon which lupins are grown.

Effect of the Growth of Lupins upon the Land.—The remarkably good result of a crop of lupins upon the fertility of the land was discussed in the previous article referred to. This beneficial effect is recognised by Suffolk light land farmers. In one case, on the farm of Mr. A. R. Rope, Leiston, Suffolk, it was found that a better oat crop followed where lupins were folded, than where they were harvested for seed.

On the farm of Mr. H. C. Boggis, at Easton Bavents, Southwold, the writer found that oats after lupins folded with sheep, did not give quite such a good crop as oats after lupins ploughed in green, when the whole bulk was available for soil improvement. Where the crop is folded with sheep, a good deal of the organic matter will disappear, being consumed by the sheep, but probably a considerable proportion of the nitrogen contained in the crop will be absorbed into the soil in the dung and urine of the animals.

Where the crop is harvested for seed much leaf and root residue is left upon the land. This is, however, very much less in bulk than the green material ploughed under where the crop is grown for green manuring. Where the seed is harvested the stems and pods of the lupins go to enrich the farmyard manure heap and so are not lost to the farm. It is recognised by all that whether the crop is harvested, or ploughed in green, the soil is greatly enriched in organic matter and nitrogen. In Nottinghamshire, Dowling* has conducted field trials to test the effect of lupins upon succeeding crops. In one case lupins were compared with buckwheat, both crops being ploughed in green.

The lupins grew luxuriantly and kept the weeds down, whilst the buckwheat was practically smothered out by spurrey. Black winter oats were sown soon after ploughing the lupins and buckwheat in, and in the following year were harvested separately.

* Report on Field Experiments, 1921 and 1922, Notts Education Committee

The oats after lupins yielded $7\frac{1}{4}$ qr. per acre—those after buckwheat yielded only $1\frac{1}{2}$ qr. per acre.

The following year a portion of the lupined area was sown with turnips without any manure of any kind and gave a crop of $9\frac{1}{2}$ tons per acre. The report states that it was a foregone conclusion that had turnips been sown without manure in an unlupined area there would have been no crop to speak of.

Suitable Climate and Soil Conditions.—As with all other crops, a sufficient supply of moisture to germinate the seed is necessary with lupins. When the crop is sown in April, for seed production, there is usually enough moisture present for this purpose. When the crop is grown for seed production a fair rainfall is beneficial during the summer, but too much rain delays the ripening of the seed, and may cause the harvest to be too late, especially on good land. When the crops is grown for green manuring or for folding, the seed is usually sown in May, June or July, and as the soils on which lupins are grown are usually very light, and retain moisture very badly, there is in some seasons, especially in the dry Eastern counties, some danger that there may not be enough moisture present to germinate the seed. Provided there is enough moisture for this the crop makes a fair growth under rather dry conditions. Should there be an ample rainfall, as was the case in 1924, very luxuriant growth will result, so that an enormous crop of green stuff is obtained.

As has been previously mentioned lupins will thrive on very poor sandy soil, even on almost pure sand, provided there is enough moisture present. It was considered in classical times that lupins do not thrive in the presence of much lime in the soil. This view is confirmed by modern experience. In Suffolk lupins seem to thrive best on soils showing a moderate degree of acidity, on which sorrel and spurrey are fairly abundant. There is, however, evidence that it is possible for a soil to be too acid even for lupins. These plants have been known to fail in small patches in fields, the small patches showing, as indicated by the great quantity of sorrel and spurrey present, a very high degree of acidity.

German writers refer to the necessity of inoculating the seed with cultures of the organism of the root nodules in order to secure satisfactory fixation of nitrogen. From the rather limited experience of lupin growing in this country this inoculation would appear to be unnecessary. Nodules have grown

satisfactorily without any such treatment in all cases which have come under the observation of the writer.

Varieties of Lupins.—The variety most commonly cultivated in Suffolk is the Blue Lupin. This kind grows rapidly, produces a very fair mass of foliage and ripens its seed satisfactorily in an average season if sown in April, provided the land is poor. If the land is too good the seed does not ripen so well. Experiments conducted by the writer with Yellow Lupins led to the conclusion that this variety was on the whole rather inferior to the blue lupin for Suffolk conditions. The yellow lupins are more branched from near the ground than are blue lupins. In Holland it is considered by some that for green manuring a mixture of blue and yellow gives better results than either variety alone.

In Suffolk the large White Lupin has been grown during the past two years, the seed having been imported from Italy. It has been used for green manuring and has given enormous crops of green material, distinctly larger than those given by the blue lupin when grown in the same field. In one case under observation, owing no doubt to the heavier crop of green material ploughed in, a heavier crop of oats resulted after the white than after the blue lupins. It is uncertain whether the seed of the large white lupin would ripen under average British conditions.

Place of Lupins in the Rotation.—Lupins as a seed crop are grown after a cereal, as a rule, and occupy the same place in the rotation as peas or beans on heavier land. When grown for sheep folding or ploughing in green, they may follow a spring or early summer fallow. In this case the lupins are the only crop obtained in the year. When they are ploughed in for green manure, the crop is open to the very grave objection that it gives no immediate financial return. In the present adverse economic conditions of agriculture this is a very serious matter and involves a whole year without any income from the land. In Holland lupins for green manuring are grown after a corn crop. This might be done in the very earliest districts of England, after such crops as rye, winter oats, or early barley. It often happens, however, that when harvest is early, the stubbles are so dry that the seed would not germinate.

The writer has never known a case where lupins were successfully grown after a cereal grain crop in Suffolk, but it might be done in a favourable season—the stubbles would

want to be clear by the end of July, and sufficiently moist to germinate the seed. There are, however, a number of crops which come off the land earlier than corn, and after which lupins can be quite successfully grown for green manuring. Amongst such crops may be mentioned early potatoes, tares and oats, green rye, trefoil, trifolium, and certain other green crops suitable for sheep folding, for hay or ensilage. It is considered by some Suffolk growers that lupins, sown fairly late, give a heavier crop of green stuff for folding or ploughing in than if sown early—say, in May. Trifolium, sown on oat or rye stubbles in autumn, is a most suitable crop for light land, and on the estate of Mr. Russel Paul, of Sutton, Woodbridge, has been found to be very suitable for growing before lupins. Mr. Gaymer, Mr. Paul's agent, adopted this plan in 1924 on land growing a good deal of sorrel, and distinctly sour. A very fair crop of trifolium was followed by an enormous crop of large white lupins, which were ploughed under in October, as a preparation for oats. In early potato districts also, where the crop of potatoes is removed in June or July, a crop of lupins could undoubtedly follow, and where farmyard manure is scarce, it might prove very valuable to increase the quantity of vegetable matter and nitrogen in the rather light soil which is often suitable for early potatoes.

In one case in Cornwall, lupins were sown during the first week of August, after early potatoes, and a crop weighing $14\frac{1}{2}$ tons of green material was weighed on the 8th November. A crop of this kind ploughed in would make a splendid preparation for the succeeding crop.

Where one crop has already been secured off the land in a given year, the cultivator is more likely to be in a position to sacrifice the rest of the year to a green manuring crop than when the whole year has to be devoted to the purpose. In a mild, showery autumn lupins will grow on until the first frost. There can be no doubt that in many cases such a plan is a very cheap way of manuring the land, especially in the case of fields situated a long way from the homestead to which it is difficult to cart farmyard manure. The expenses on the crop are simply the cost of ploughing, drilling and seed. In many cases this will mean less than the cost of carting and spreading farmyard manure, even if that substance were obtained free of cost.

The Lupin as a Fodder Crop.—As was previously mentioned, lupins contain poisonous properties, and care is necessary in feeding them to animals. They are occasionally made into hay

on the Continent. They are difficult to dry and no case is on record in which they have been made into hay in this country. A small quantity of lupin silage and lupin and buckwheat silage was made in Suffolk.

It had the following composition :—

	Lupin silage.	*Lupin and buckwheat silage.*
Moisture	83.46	80.87
Oil or Ether Extract	1.25	1.53
Albuminoids	3.15	3.46
Carbohydrates	4.13	6.23
Fibre	5.94	6.48
Ash	2.07	1.43

Some of this silage was fed experimentally to a sheep on the farm of Sir G. Manners at Woodbridge and this animal consumed it with no ill effects. There appears to be no reason, therefore, why lupins should not be made into silage and fed to sheep, always bearing in mind the precautions mentioned below, which are necessary owing to the poisonous properties of the plant.

In Suffolk it is the custom for light land farmers to grow lupins for folding sheep upon them. A number of farmers who do this successfully were previously mentioned* and, provided care is taken that the sheep do not go on to the lupins when hungry and that the lupins only constitute a portion of their diet, the risk of loss by poisoning is small.

Long† points out that large numbers of sheep have been affected by lupin poisoning in the German Empire, and that the most harmful species is the yellow lupin, although the blue lupin may also be poisonous. He, however, states that it must not be thought that all crops of lupin are poisonous, as they are extensively grown on the Continent for fodder purposes and are usually harmless. Desiccation does not render the plant innocuous, the seeds and hay being poisonous. In this connection it is worthy of note that Suffolk experience with the folding of sheep on lupins has been almost entirely with the blue lupin. In one case in which large white lupins were folded symptoms of poisoning very quickly arose, and the sheep had to be removed.

Long also states that much loss has occurred in America from lupin poisoning with sheep, and that sheep may become gradually immune to the poison by eating lupins regularly.

* This *Journal*, Jan., 1920.

† H. C. Long, Plants Poisonous to Live Stock, 2nd Edition, Cambridge University Press.

He mentions that lupins are far more dangerous when they bear ripe seed. Cut and made into hay before the pods form they are much less dangerous.

The lupin does not appear always to be poisonous—but only under certain conditions, which are not too well defined. Marsh and Clawson found alkaloids to be the cause of the trouble. Chesnut and Wilcox give the symptoms, as acute cerebral congestion, with great mental excitement, the sheep rushing about and butting into things—following is a stage characterised by irregularity of movement, violent spasms and falling fits. The convulsions resemble to some extent those caused by strychnine.

In spite of the somewhat alarming accounts of loss from lupin poisoning in other parts of the world, the Suffolk farmer has no hesitation whatever in folding his sheep upon blue lupins provided certain precautions are taken. It is important that the folding of lupins should be begun gradually, especially if much seed be present in the pods. If this precaution is neglected the sheep become paralysed. It is also undesirable to fold pregnant ewes upon lupins. It is considered that lupins fed in summer help to expel intestinal worms. This opinion was also held by classical writers.

Mr. S. R. Sherwood, the well-known Suffolk sheep breeder, of Playford, Ipswich, in a paper which he read at the International Conference on Sheep-Breeding, held at Derby in 1921, referred to the value of the lupin. He said: "It is not a high-class feed but it has this great advantage—it will flourish on the very poorest light land. No stock with the exception of sheep will eat it, and even they will only nibble it for the first day or two; but when accustomed to it, they will eat it readily. I know no better crop to plough in as green manure."

Lupins may be grown alone for folding, or they may be mixed with other plants suitable for sheep feed. If this is done the danger of poisoning will be greatly reduced, and may disappear altogether. A mixture of oats, tares and lupins has been found suitable for sowing fairly early. For later sowing tares, rape and lupins make a very good mixture.

A seeding of 1 bushel of lupins per acre drilled in, with 2 lb. per acre of rape and 2 lb. of white turnip seed has been found successful for June or July sowing. A mixture of 1 bushel of lupins and ½ bushel of buckwheat per acre was also found to produce a useful crop for folding purposes on very poor sandy

ground, in some experiments conducted by the writer. This mixture came up much thicker than a piece of the same field sown with 2 bushels of lupins per acre. In the dry season of 1921 it was sown on 22nd June and on 2nd September gave 5 tons 2 cwt. of green stuff per acre, although hardly any rain fell during this period.

Utilisation of Lupin Grain.—The cultivation of lupins in this country is severely handicapped by the violent fluctuations which take place in the price of lupin grain owing to the fact that the only market which exists for it is for seed. Once the demand for seed is satisfied, the grain sometimes becomes extremely cheap and almost unsaleable. The limited area under lupins and the influence of season also tends to cause the seed to be very dear one year and very cheap a year or two later.

A few Suffolk flockmasters use the grain for feeding to sheep when it is cheap. From $\frac{1}{4}$ lb. to not more than $\frac{1}{3}$ lb. per head daily has been found to be safe. More than this quantity causes paralysis. In any case untreated lupin grain should not be fed to pregnant ewes. The work done at Continental research stations upon the removal of the poisons from lupins has been previously referred to. The conclusion arrived at—that lupins deprived of these poisonous properties are almost equal to soya cake for milk production—is of considerable economic importance to owners and occupiers of light land in this country, and also to manufacturers of cattle foods, cakes, etc.

There would appear to be no reason whatever why lupin grain should not be treated by one of the processes mentioned previously, so that its poisonous properties were removed, and then sold as cattle food. The process could probably be best carried out on a large scale by manufacturers of cattle food. There can be very little doubt that occupiers of poor light land would be prepared to contract with cake manufacturers to grow lupins, in the same way that sugar beet growers contract with sugar factories.

The matter seems to be well worthy of the attention of both cake manufacturers and farmers, and if such a scheme could be started it would greatly increase the productivity of poor light land, by providing a ready market for one of the few crops which will grow upon it. It would also benefit cake manufacturers and agriculturists in all parts of England by introducing a new and very valuable home-grown cattle foodstuff to the British market.

Lupin Meal as Manure.—It has also been suggested to the writer that lupin meal would have a considerable value as a manure if the process of extracting the poison from the grain were found to be impracticable.

It is possible that the oil present in the grain—4 to 7 per cent. according to Kellner—would be worth extracting. If this were so the residue would be very valuable as an organic nitrogenous manure similar to rape cake.

Lupin grain in its original state contains a very high percentage of albuminoids. Very few analyses, however, are available. Kellner gives 29 per cent. of albuminoids for white and blue lupins and 38 per cent. for yellow lupins. Other Continental workers give 41 per cent. Taking an average figure it is quite evident that about 5 per cent. of nitrogen would be present, *i.e.*, a similar quantity to that present in rape cake. An oil-extracted meal would contain a rather higher percentage.

Summary.—The value of the lupin is by no means sufficiently understood in this country. Like all leguminous crops it is able to assimilate the nitrogen of the air and enrich the soil. The lupin is, however, specially valuable in that it is one of the very few plants of economic importance which will thrive on light land poor in lime.

When grown on such land, whether for seed, for folding, or for ploughing in green, the soil is greatly enriched and almost always gives far better crops for one or two years.

Owing to its poisonous properties, care must be taken when folding the crop, or feeding the grain to sheep—which are the only farm animals for which the untreated grain is at all suited. Several processes are used on the Continent whereby the lupins are deprived of their poisonous properties. It appears that when treated by these processes the lupins are quite safe to feed to all classes of stock, and constitute a valuable food rich in albuminoids.

If cake manufacturers in this country arranged to prepare lupins for stock food in this way, a ready market would be always available for the sale of lupin grain. This would be a great benefit to the grower and would increase the productivity of poor light land, by encouraging the growth of lupins. The introduction of a new cattle food, rich in albuminoids would be of benefit to all agriculturists. There is also a possibility that the manufacture of an organic nitrogenous manure from lupin grain might prove profitable.

THEORY OF EXPERIMENTAL ERROR.

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THE agricultural experimenter is inclined to bring the charge against the statistican that he delights in playing with the figures that experiments provide, but that he does not understand much about the plants and animals that supply those figures, and therefore that he cannot criticise adequately. The statistician is inclined to bring the charge against the experimenter that he does not mind how his experiment is arranged so long as he gets a figure. He neither knows the trustworthiness of this figure nor how to ascertain its trustworthiness.

It is important therefore for all who are concerned with agricultural experiments to make themselves familiar with the theory of probable error, and find out what the statistician wants to do and whether it can be carried into practice.

I propose to treat this subject from the strictly practical point of view and to deal with statistics not for their own sake but only in so far as they will help with our work. I also wish to make it clear that I do not seek in any way to give advice, but only to give some account of the theory of probable error.

Chance Errors with Single Plots.—In seeking material on which to base this lecture I came to the conclusion that the facts brought out by the work of Sir Daniel Hall and Mr. Mercer fourteen years ago would best suit my purpose. The experiment on which the whole of this lecture is based is a perfectly simple one. An acre was marked out on a field of mangolds. That was divided up into small samples, and those samples were separately studied to find out how variable the yield could be on different parts of the field because of the influence of soil, insects, clumsy workmen, bad seed drill, or any other circumstances. At the expense of wearying you with repetition, I should like to explain how this work was conducted.

An acre was divided into 10 parts one way and 20 parts another way, thus giving 200 plots, each measuring 1/200th of an acre. On each of these plots the roots were lifted, cleaned and weighed; the yield on one plot was 376 lb., on another 371, on another 355, and so on. Now, the first thing we have to do is to collect together those results in a convenient way; we have to discover how they are scattered about. The most convenient way to study

* Paper read at the Conference of Agricultural Organisers, Oxford, April, 1925.

the scatter is this. Collect the results together into 10-lb. groups, and ascertain the number in each group as follows :—

Group.	No. of plots in group.	Group.	No. of plots in group.
From 260 to 269 lb.	1	From 330 to 339 lb.	39
,, 270 ,, 270 ,,	2	,, 340 ,, 349 ,,	30
,, 280 ,, 289 ,,	2	,, 350 ,, 359 ,,	18
,, 290 ,, 299 ,,	9	,, 360 ,, 369 ,,	8
,, 300 ,, 309 ,,	23	,, 370 ,, 379 ,,	3
,, 310 ,, 319 ,,	24	,, 380 ,, 389 ,,	1
,, 320 ,, 329 ,,	40		

The biggest group was comprised of those plots whose yield was between 320 and 329 lb.; there were 40 such plots. The next group contained 39 plots. A number of causes may have been responsible for the plot which gave the lowest yield of 267 lb. For instance, the drill when sowing this plot may have been clogged. Similarly, the plot which gave the highest yield of 384 lb. may have been on the site of last year's muck-heap—no one knows the favourable circumstances. The true average for the yield of all the plots was 328.6 lb.

Now, as Sir Daniel Hall pointed out in the previous lecture*, the most convenient way of dealing with this grouping is to make a curve (see p. 328). Take the base line as the yield line and mark off the yields at 10 lb. intervals along it. Draw vertical lines at each 10 lb. interval corresponding in length to the number of results within the 10 lb. group and join the points so obtained to make the curve. This curve represents in a convenient way how the yields of the plots are scattered about.

We must next proceed to make certain deductions from this curve. The first deduction is that if you put down 200 plots of mangolds on this field you will have yields ranging from 267 to 384 lb., and the particular result you get from a single plot will depend on the position of your plot on the field. You will make the criticism that you would not put down so small a plot as 1/200th acre: your plot would be larger. If you take larger plots, your work will be more reliable, but you will by no means escape from the problem. These results show the danger of arguing from a single plot. If you take one plot you have only one figure and nothing by which to check it. If you have several plots of the same kind you have several figures and are in a position to make some sort of check. One figure can never check itself, and that is why, in principle, the single plot must come under suspicion. One of the purposes of this theory of probable error is to show how many plots you need in the sample you take from your field, to get any desired degree of reliability.

* This *Journal*, June, 1925, p. 202.

The probable error theory will also show, for example, how many bullocks you would have to feed on a certain ration to determine the value of that ration with a given degree of accuracy. Let us examine the plot figures in another way. Suppose that in a hat are 200 tickets on which are written the yields from the 200 plots. Putting down plots on the field is like drawing tickets from the hat—you draw one or more tickets, chance decides what particular values you draw, and separate draws or sets of draws may give very different values.

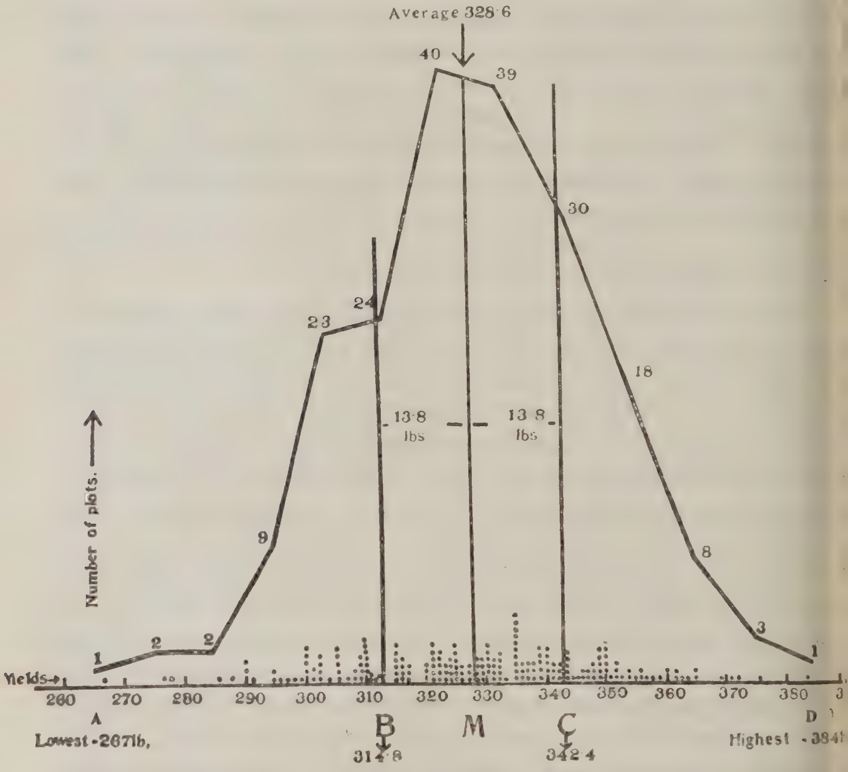

FIG. 1.—Showing yields of the 200 small Mangold Plots.

It is not in the least stretching the comparison to say that putting down a single plot on a field is just as objectionable in principle as trying to tell the average value of tickets bearing these different yield numbers by drawing from the hat any one of the 200.

It will be seen from the curve in Fig. 1, that of the 200 plots, 40 lie between the values of 320 and 329 lb. There are thus 160 in the other groups. Now if you dip your hand into the hat the chances that you will draw a ticket whose value lies within the 320-329 lb. group are as 40 is to 160, *i.e.*, the betting is 4 to 1 against your drawing a yield within this group.

In the same way you can find the betting on drawing out of the hat a ticket whose value is less than, say, 310. This is the same problem as going into the field, putting down a 1/200th of an acre plot, and of the chance that the yield from it will be less than 310 lb. Thirty-seven tickets have values less than 310. The chances against your drawing a value of less than 310 are 163 to 37, or $4\frac{1}{2}$ to 1. That is a simple thing to understand and is the whole principle on which probable error is based.

How Probable Error is Found.—Now the true average of the yields of the 200 plots is 328.6 lb. If you go downwards through the fifty yields next below the average in order of yield, you will come to a value of about 314.8 lb., and if you take the fifty plots in ascending order of yield above the average you will come to a value of about 342.4 lb. Half the plots therefore have values between 314.8 and 342.4 lb., *i.e.*, half of the tickets in the hat have values between about 314 and 342. It is therefore absolutely even chances that if you pull out one ticket its value will lie between 314 and 342 lb.

Now these two points are very critical ones. Half of our plot values lie within a range of 13.8 lb. above and below the true average; and this 13.8 lb. is called the probable error of a single plot-yield. There is nothing more magical in probable error than that. To find probable error, then, make a number of measurements of the same kind, find the average, and the interval above and below the average within which half your results lie is the probable error. As it is even betting that any single value will lie within this range it is obvious that the probable error gives some idea of the reliability of your results.

How do we find the probable error in practice? In experiments we can very rarely get 200 measurements of the same thing. We usually have to content ourselves with a much smaller number of observations. The simple method of finding the probable error that I have outlined is not the most convenient. We have therefore to rely on the theory of the laws of chance.

In the first place we must recognise that in our measurements we shall always get a scatter of values as indicated by the frequency curve. In the next place we must recognise that when pure chance operates, we get the same scatter of values. Let me demonstrate this point. Let us consider the results we may get by spinning ten pennies. It would clearly be possible to get ten heads, or nine heads and one tail, or eight heads and two tails, . . . five heads and five tails, and so on, to no heads and ten tails. Once in 1,024 times you would get ten heads, once in

1,024 times you would get ten tails; the most common result would be five heads and five tails; the next most common would be four heads and six tails or six heads and four tails, and so on. The frequency curve in this case where pure chance operates would be very similar in essential form to that we have been considering for experiments. By this similarity the idea of probable error in experimental work was suggested.

Imagine ten possible causes controlling the yield in our experiments and suppose each could have only a high or a low value corresponding to the head and tail of a penny. Then it is 1 : 1,024 that all ten causes will operate at high value on any plot. There are many chance differences in the circumstances by which yield is controlled. Generally speaking, agricultural experiments give you a scatter of values which resembles that which you get when chance operates.

The curves of pure chance are not all the same, any more than the curves of experimental values are the same, *e.g.*, the curve for tossing 10 pennies differs in actual shape though not in essential form from that for tossing 20 pennies. If you had put down potatoes on the plots on the mangold field the curve of yields would have the same general form but not the same shape; it might be taller or flatter for example. As the general form of the pure chance curve is the same as the general form of the curve of values in agricultural experiments repeated many times, we are justified in using anything the mathematicians deduce as to chance curves to help us in interpreting the curves of values we get from our agricultural experiments.

I want to speak only of two mathematical deductions that the statistician makes from his chance curves. He has a convenient formula rendering unnecessary the counting of plots above and below the average, so that in practice to get the probable error from any set of experimental results we use this formula. The other deduction is that the odds are about 20 to 1 that if you take any single value from a whole set of values (or if you take any single ticket from the hat) it will lie between the limits of three times the probable error above the average, and three times below. Now 20 to 1 is pretty long odds, so it has become customary to accept this range of three times the probable error above the average and three times below the average as the interval in which we can reckon practically all our values will lie. Correspondingly this interval represents the total range about the true average over which we must expect single plot values to be scattered. It is the " margin " we must allow for " chance " errors or differences.

Size of Plot.—I must now refer to the effect of the size of the plot you use. I can compress the whole matter into this form. If you take very small plots you get large probable errors. If you take larger plots your probable error grows less. The effect of the size of a plot on the probable error has been carefully worked out, and two distinct facts emerge. The first is that the size of about 1/40th of an acre is the best. Above 1/40th of an acre the probable error does not fall very quickly with increase of size. Even with 1/10th of an acre plots the probable error is very considerable. It is convenient to put the probable error as a percentage of the true average, and with 1/10th acre plots it is 3 per cent. of the true average. That is to say that if you were to put down, say, 100 1/10th acre plots of a certain variety of wheat the betting would be 20 to 1 that any single result will lie inside the range of from 9 or 10 per cent. of the true average above that average, to the same distance below that average. That puts the state of affairs as regards a single plot. Whether we like it or not, we have got to allow for a deviation from the true average of 10 per cent. up and 10 per cent. down on the single plot. A bigger plot does not help very much. The probable error of even an acre plot is of this order.

Number of Plots.—It will be evident that a single plot experiment has a very low reliability. I think I shall be quite well understood if I say that to publish the yield of a single plot without disclosing at the same time the uncertainties attaching to that yield is, to put it at its lowest, very misleading. If you grow only a single plot then you have this wide range of possibilities. Well, common sense says why not put in a number of plots and take the average. Suppose you put in sets of five at a time, and repeat your sets. Your average yield (from 5 plots) will differ each time, but the scatter will be less, the probable error less and the reliability greater. The whole thing can be crystallised in this way. The probable error enables you to appreciate how much more reliable an average is than a single plot. The probable error of a single plot turns out to be, say, 13.8 lb. If instead of taking a single plot you take the average of five plots, the statistician would tell you that the probable error of the average of five plots is 13.8 divided by the square root of five, for ten plots it is 13.8 divided by the square root of ten. The probable error of the average is the probable error of a single plot divided by the square root of the number of plots on which you base your average. This shows how the probable error is dependent upon the number of plots that contribute to your

average. I should mention that if you take plots of (say) three varieties of wheat a good deal turns on how you arrange these plots with regard to each other. I am, however, unable to deal with the question of arrangement here.

Probable Error of Differences.—I have one final point to deal with, and it is the most important. It is the probable error of a difference. In our experiments everything turns on differences. We want to know the difference between two varieties of wheat or two pig rations. Suppose you were testing two wheat varieties, and had five plots of each; you would find the same scatter of individual differences about the average difference that we have dealt with above. There is a simple formula for finding the probable error of the difference between two averages. Let us suppose that the average yield of 10 plots of 1/40th acre of Squareheads Master is 68 lb. and of 10 plots of Yeoman 62 lb. Is the difference of 6 lb. significant? Our formula gives us the probable error of this difference as 2.5 lb. Thus the margin we must allow for differences produced solely by chance (dissimilar soil conditions, etc.) is $3 \times 2.5 = 7.5$ lb. Our difference of 6 lb. is not safe therefore. We can only say that possibly it simply represents chance effects. The rate of yield per acre is about 43 bushels of Squareheads Master and 39 bushels of Yeoman. The difference is 4 bushels to the acre; but our examination has shown that the difference is not statistically reliable.

Summary.—Let me recapitulate the more important points. The first is that single values in any experiment cannot be depended on. Possibly, however, you may only be able to get a single value. Perhaps there are circumstances in which you cannot put down a number of plots. This from the point of view of accuracy is a disadvantage, but single plots of each of three varieties may give useful information such as resistance to drought, lodging, sprouting in the stook, etc. It is a waste of time, however, to weigh the produce from a single plot. In the second place it is not justifiable to give the result of an experiment even if it is an average result, unless the reliability of the result is defined by the probable error. Next, a difference is not reliable unless it is at least three times the probable error. Lastly all the help that statisticians can give will never take away the necessity for careful handling of plots.

I would like to suggest that a common cause of error and weakness in experimental work is the temptation to try to include too much in the experiments. If instead of attempting to measure the yields of twenty varieties of wheat you measure those

of four varieties you have five times the number of observations, and the reliability of results will have been increased correspondingly without any additional work. The practical deduction is to reduce the number of points tested and so increase reliability in experiments.

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APPLE PACKING IN WASHINGTON AND OREGON.

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WASHINGTON STATE lies immediately to the south of the Okanagan Valley of British Columbia, and for apple production is one of the most important in America. It is the area in which box packing was first started and where this system has been most developed.

Entering the State at the port of Seattle on the Pacific Ocean, it would appear that the district usually experiences a heavy rainfall. but the fruit area is some 150-180 miles inland, over the Cascade Mountains, where the valleys look as dry as dust and the mountain sides produce little beyond backed-up bunch grass. At Wenatchee a number of these waste and barren valleys, all having an elevation between 700 and 1,000 ft., have been made fertile by a great scheme of irrigation whereby the snow water from the mountains is captured and led to water the soils over a hundred thousand acres in extent, of which nearly 40,000 acres are planted to fruit. Immediately south of these valleys lies a range of high mountains, and then comes the Great Valley of the Yakima River, in which more than 40,000 acres of fruit, in one continuous stretch, have been planted on the hilly slopes, with asparagus, lettuce and other vegetables on the lower parts by the river. These two areas of Wenatchee and Yakima have an annual production in apples alone exceeding 15,000,000 boxes, and the districts are known amongst apple distributors the world over. The next important apple district in Washington State is that of Spokane with an acreage nearly equal to that of Yakima. but the soils have proved less suitable and the total production is much less.

On an upland region of rolling hills at Walla Walla there is a fourth important area and many smaller and less important ones in other valleys. In fact, wherever it has been found possible to secure adequate supplies of water by irrigation schemes, apple

producing industries have sprung up and swelled the annual production of this State to nearly 20,000,000 boxes. All the fruit is packed in boxes.

The towns of Yakima, Spokane and Wenatchee are small and even with the growing and industrious port of Seattle the population of the State is only $1\frac{1}{3}$ millions, so that a very small proportion of the apples are required for home use, and the vast majority have to be sent away by rail over the high Rocky Mountains and across the prairie plain of Central America to the eastern towns of Chicago, Detroit, Minneapolis, Philadelphia and New York, or by rail to Seattle for shipment via the Panama Canal to England, Germany and Scandinavia.

The distributing systems which have been established at Wenatchee and Yakima have all been framed to supply apples at short notice to any markets in the world. The farms in all these areas are small, most of them averaging not over fifteen acres, and many less, so that it would be impossible for any one grower to market his fruit individually or, in the case of some, to undertake the grading and packing.

At both Yakima and Wenatchee fruitmen with business talent have built up during the past twenty years an extensive business in shipping apples to distant markets; some buy the apples from the growers, already graded and packed, others prefer to buy the "orchard run" apples in boxes, and carry out the grading and packing with their own staff. These independent shippers handle seventy-five per cent. of the crop and appear to be making a comfortable living from the business. The remaining twenty-five per cent. is sold for the growers by one or other of the Growers' Associations or Unions which have been created.

In this State it has been difficult to trace the origin and progress of the Association movement, because of its varied results. Some Growers' Associations formed in the early days have either failed or been repeatedly reconstructed, while a few have made good, so that no continuous line of either failure or progress can be recorded. At Yakima about 20 per cent. of the growers have joined in forming two distinct associations for the handling of the fruit crops, each about the same size—one known as the big Y or The Yakima Fruit Growers' Association, and the other known as the County Horticultural Union.

Yakima Fruit Growers' Association.—This Association, now popularly known as the Big Y (for that is the brand on the labels), was organised in 1911 as a co-operative association for

the purpose of improving the production, packing and marketing of the fruits from the orchards in the Yakima Valley, but has undergone a number of changes in both policy and personnel. It was re-organised in 1918 along the present lines, which are said to be well adapted to the needs of the district. It has 1,000 members, each of whom must hold not less than a $10 (£2 10s.) share, and it is registered as a Joint Stock Company with a capital of $350,000 (£80,000). Though a co-operative association, it has centralised management with authority vested in a Board of Directors, and its operations are carried on by a permanent staff of employees.

The area in which this association works extends from Selah at the top right down the valley to Kennewick, a distance of approximately 125 miles, so it became necessary for the association to establish fruit-packing stations all down the valley at nearly every railway station where the fruit could be delivered conveniently and packed on communal lines. There are no local associations of growers in charge of the management of these local houses as in the Okanagan Valley of British Columbia. The general policy is conducted by the Central Executive and enforced by a packing-house superintendent in charge of all the houses—though each is under the care of a local manager or foreman. The houses are of different sizes to meet the requirements of the respective areas, and of varying shapes influenced by the land available at the rail stations. The house at Gleed is said to be typical of the district. It is situated alongside the rail lines and constructed of wood—not luxurious but practical, roomy but not artistic. It is divided into four distinct portions—the platform (80 ft. by 20 ft.) on which the fruit is received before grading; the grading room (80 ft. by 20 ft.) in which the grading and packing are performed; the temporary store (80 ft. by 80 ft.), and a frost-proof store (900 ft. by 60 ft.). In addition there is a basement under the frost-proof store in which the orchard run fruit is stored before packing.

Method of Grading and Packing.—The growers deliver the orchard run fruit in new standard boxes to the receiving platform, where it is checked and the record entered in books, and a preliminary receipt handed to the grower. After being checked it is conveyed automatically either to the basement for storage or to the grader for handling. Here the fruit is fed on to the sorting table of a Cutler machine, where it is conveyed by belts past the sorters. These sorters (16 girls) sit where they can see every apple as it passes and grade it, as to colour and

condition into Extra Fancy, Fancy, C. Grade, or Culls, by placing the apples on to the conveyor belts for those grades. Each grade of fruit then passes to the sizing machine, which weighs each apple, and distributes it according to its weight to one or other of the twenty bins alongside. The packers (5 men and 5 girls) wear cotton gloves to prevent injury to the hands and take the apples from the bins, wrap them in paper and place them in boxes which have been passed overhead on an automatic conveyor before being emptied on the sorting table. The number of sorters appeared excessive, but the writer was told that only by using a large number of sorters could a high standard of grade be maintained. The packers worked very quickly and were said to average 150 boxes each per day, making a total daily output for the house of 1,500 boxes, a speed which is kept up day by day, week by week, as long as the crop lasts. Generally, the Gleed output is 100,000 boxes per year. The packed boxes are put on to gravity conveyers and taken to the press at the end of the room where the boxes are lidded, stamped with grade, number of packer, number and variety of apples, etc., and then passed into the next room for checking and storing. Besides the sorters and packers there are truckers, dumpers, lidders, labellers and a receiving crew to check the fruits, making a total force of nearly fifty people.

The other thirteen houses work on similar lines, though in some of them fruits such as Bartlett and Beurre D'Anjou Pears, Elberta Peaches, Prunes, Apricots, Bing Cherries, and Clark Seedling Strawberries are packed in addition to the apple crop.

Storage.—Four of these packing houses have been provided with cold storage plants, so that the crops can be cooled before shipment, or when the markets are glutted the packed boxes from all the packing stations can be held over and marketed to better advantage.

At Kennewick, at the eastern end, there is a cold storage capacity of 80,000 boxes; at Zillah a very large plant with cold storage capacity of 375,000 boxes; and at Sawyer for 65,000 boxes. In these three, and in the Yakima house, the Association has cold storage capacity for 500,000 boxes. The cold chambers are used also for cooling peaches, strawberries, etc., before shipment. In the case of pears, the fruit as soon as received from the grower is sent to the pre-cooling room, where it is kept in a very low temperature for a sufficient time to cool each pear thoroughly to the centre, thus checking the ripening period. After being pre-cooled, the pears are passed through

Fig. 1.—The Packing House of the County Horticultural Union, Yakima, showing four Ideal Graders.

the grading and sizing rooms, packed and passed back into cold storage until shipped to the market.

Such is the way that the fruit of 85 per cent. of the members of the Yakima Growers' Association is dealt with at a cost per box of apples of 1s. 7d. for packing, paper, etc., 3d. for overhead charges, 2d. for warehousing and cold storage, together with a selling charge of 4d., making a total charge of 2s. 4d. per box.

Payment and Advances.—Growers are furnished with spray materials, and other orchard supplies, up to the probable limit of the seasonal requirements at current prices without interest. Pre-harvest advances, for thinning and other orchard operations, in limited amounts, are made, these advances being secured on growers' notes. Upon the delivery of the fruit to the warehouse, other advances are made on a fixed schedule, in amounts depending upon the growers' needs and the standing of individual accounts. Not infrequently growers receive the larger proportion of the money coming to them long before the closing of the pools. Soft fruit pools are short-time pools, that is weekly, or semi-weekly, while practically all apple pools are for the season. Payment on the pool system was explained in an article in this *Journal* for Feb., 1925, page 1,044.

Horticultural Union.—The Horticultural Union at Yakima markets about the same quantity of produce as the Big Y, though its membership list is barely five hundred. It is a company of long standing, registered as a Joint Stock Company with $500,000 capital of which fully 86 per cent. has been subscribed by its present shipping members. Its annual business exceeds $3.000,000 (£600,000).

The policy of the Union is determined by a Board of Directors and its business transacted by a Manager, Accountant, Warehouse Superintendent, Inspectors and packing-house staff. The Union has been formed more for the purpose of erecting cold storage plant and as a selling agency than as an organisation to undertake packing. though to some extent that also is done. Two-thirds of the fruit handled is. however, packed by the growers in their ranch houses on standards fixed by the Directors of the Union, but these boxes are inspected before they are taken over for storage by the Union, and in that way the Union is able to maintain an even grade in the absence of central packing. For the benefit of the smaller grower, seven packing houses have been established at various centres, in which commun packing is practised much in the same way as has been descr

for other houses, though most of the grading and sizing of the apples is done by hand.

Method of Grading and Packing.—The packing room at Yakima is very large, well lighted with glass side lights near the roof, and equipped with most complete machinery for the automatic handling of box fruit. Five Ideal grading machines have been installed quite recently to facilitate the work of sorting the fruit into grades and sizes. The Ideal machines work very silently, being simply constructed of a series of long moving conveyors indented at every 6 in. with holes $\frac{1}{2}$ in. deep into which each fruit is placed by the sorters. With this machine the sorters have to handle every fruit and place each one into a hole on the proper band. The fruits travel down the table on the moving bands and pass under other bands which move at right angles; the latter are set at varying heights along the table so that the large fruits are sent into the first bins and the rest pass on, being cast into the bins automatically in accordance with their size. The fruits are set into the holes of the bands on their sides, so that when shot into the bins there is little risk of any stem injury, and for that reason the Ideal is said to be a good machine for grading and sizing apples with long stems and soft pears. The machine is slower than the Cutler machine and sizes irregularly shaped apples less perfectly, so that the girls can pack less rapidly, but has the advantage of being much quieter and rather cheaper. The apples are packed into boxes from the bins and then taken on elevators into the adjoining cold storage rooms where 400,000 boxes of apples can be held at 32 to 33° F. for weeks on end.

The cold storage plant is worked on the compressed ammonia principle, and is in almost continuous use. Elevators have been run through every chamber of the cold stores so that fruit from the packing shed may be run to any part of the storage building; or from any part of the storage building away out to the railway platform right into the railway car for loading. Little man handling is necessary, the elevators doing the work more quietly and at less expense.

Marketing.—The Union has adopted a label for its boxes which is now recognised as a symbol for good packing throughout the States. The Blue Ribbon Brand, The Red Ribbon Brand and The White Ribbon Brand designate the three grades of fruit marketed, and on account of its reputation the Union is able to sell practically its whole output at f.o.b. price at Yakima to merchants situated in the distant markets of the great towns of the States.

The Horticultural Union works very efficiently and cheaply, for the cost to members for packing, storing and selling is but 2s. 0½d. per box of apples. Naturally, such a successful association has little difficulty in keeping its old members or in securing new members, though in practice the Directors have not found it the best policy to take every additional member as soon as he makes application, but to place his name on a waiting list for admission to the Union as soon as the expanding business of the Union safely permits the management to deal with a larger supply of fruit. The waiting list at the present time exceeds in number the present list of members, so that in a way it seems to be a respected privilege to belong to this well-managed, though somewhat conservative, co-operative union.

The Big Y and the Horticultural Union are in practice Joint Stock Companies, with a well-defined business in packing, storage and selling, though they work on co-operative lines for their members, no profits can be made, and the growers receive the actual selling price, less the cost of packing and storage and the overhead charges of the central organisation. Both organisations sell the fruit at f.o.b. rates at Yakima, and leave to the purchaser the responsibility of feeding them to the market. At times fruit is sold by one of these companies to wholesale merchants in Yakima who probably are, or think they are, in a position to place a particular lot in the market to better advantage. The associations have apparently made no attempt to deal with the question of "Orderly Marketing" beyond the methods adopted by the average independent shipper, nor has it been possible to form any working arrangement with distributors in the great fruit markets other than those open to the large independent shippers.

In effect, the Growers' Association and the Horticultural Union have displaced a number of independent shippers at the producing end and are now trading on much the same lines and in much the same way that an independent shipper does. Both organisations have, however, taken a real live interest in protecting the growers' interest, and in looking after the fruit industry in the broadest sense. They have done much to stimulate the best methods of culture, encouraged the thinning of fruits, and the spraying of trees to keep down pests, and have developed the grading and packing of fruit to a high standard.

It is in these technical achievements that the associations have proved so valuable rather than in securing for the grower a greater portion of the price ultimately paid by the consumer.

The Hood River Valley, Oregon.—The growers in the Hood River Valley were the pioneers of the export trade in box apples to Great Britain, which business they have developed since 1901 until at the present time about one-third of the total crop—600,000 boxes—is marketed in Great Britain.

Though less than one hundred miles distant from the Yakima area, the Hood River Valley is not comparable with the apple regions of Washington or British Columbia. Instead of a dry climate, it has a rainfall equalling that of Kent. The trees have a different habit of growth and lower average yields are obtained than in most other apple sections of the North-west Pacific States. The lighter yields are very largely accounted for by the fact that Yellow Newtown and Spitzenberg, well known for high quality but rather shy bearing varieties, predominate.

The area is very compact, being situated in a valley some 8 miles wide and 25 miles long, stretching from the Columbia River to Mt. Hood. This mountain of the Cascade Range is covered with snow, so that plenty of water is available and summer irrigation of the orchards is generally practised.

The growers have not neglected other kinds of fruit, and an extensive business in strawberries and Bartlett and Beurré D'Anjou pears has been built up. Recent plantings are to pears rather than apples, for great difficulties have been experienced in the last few years in producing the latter at a profit. The fruit produced throughout the whole valley must come by rail or car into Hood River town on the Columbia River for shipment by rail to the eastern towns of the States, or by rail westward for 60 miles to Portland for shipment to Great Britian via the Panama Canal. Practically none of the fruit is required locally.

These conditions naturally brought into existence a number of shipping merchants who purchased the packed boxes of fruit from the growers and marketed them on their own account; but as early as 1891 some of the growers formed a Growers' Union, which after a series of changes and developments has now emerged as the Hood River Apple Growers' Association, a first class organisation of growers which has established cold storage accommodation for the fruits and which also acts as a selling agency for most of the fruits produced in the valley. It is said to handle at least 85 per cent. of the total fruit crop of the valley, and has an annual turnover of nearly $3,000,000 (£600,000).

The actual packing of the fruits is done in most instances on the farm ranches, where nearly every grower has his own small packing station where bench packing is done. Only a very few have fitted graders of either the Cutler small machine or the Ideal. The packing, however, has to be done to standards set by a Growers' Committee of the Association: and before the fruit is accepted for storage or for marketing it is inspected by field inspectors who are employees of the Growers' Association. There are many who have doubted the possibility of maintaining a level standard of pack on a system of farm packing, but the experience of this Association shows clearly that a level pack is possible providing a skilled staff of impartial inspectors are available to enforce the standards and with sufficient courage to grade down packs where growers have attempted to get inferior fruits through. At one place—Parkdale—in the Upper Valley, the Association has found it necessary to erect a medium-sized packing house fitted with two grading machines—the one a Cutler Grader large machine and the other an Ideal. The former make of machine sized irregularly shaped apples more accurately, and the packers stated they preferred to pack from the Cutler. On the other hand the Ideal was very much less noisy and was said to cause less damage to pears, for the grading of which it was installed.

Growers sending their apples to the Parkdale House for packing and warehousing have to pay the actual cost of packing, which can only be finally determined at the end of the season. For 1923, when 49,952 boxes were handled, the charges made were:—labour $5\frac{1}{2}$d., materials $11\frac{1}{2}$d., overhead charges 3d., or 1s. 8d. per box in all. For cold storage and selling an additional charge is made.

Cold Storage.—The bulk of the apples are Newtown Pippins, which is a late variety if properly stored. The Association soon realised the assistance that cold storage could give, and accordingly have erected near the railway station in Hood River Town, a gigantic cold storage building in which half a million boxes can be stored with ease. The cost of the building and equipment, $500,000, was secured on notes from the growers and loans from the bank, whilst the annual maintenance charges are met by charging a fee on each box placed in storage.

The water power of the Hood River generates electricity to work the ammonia compressor of the cold storage plant, to carry out the lighting of the whole building, and to drive the

mechanical elevators with which the building is abundantly equipped.

The early attempts at cold storage were not entirely successful, due generally to the decay of some blemished fruits which had passed the sorters and packers, but with experience and greater skill these have been eliminated—and with the development of the oil wrap instead of tissue paper wraps few difficulties now arise. The chambers have to be well ventilated by forced circulation of air, and kept at a steady even temperature of 32 to 33° F. with a suitable air humidity and the apples keep fresh and bright right until February, March and even later.

Cold storage has given great hopes to the pear industry, and made it possible to market even soft varieties in good condition in distant markets. Bartletts (William Bon Chrêtien) and Beurré D'Anjou are largely grown, and without cold storage, total losses of Bartletts often resulted. Now the Bartletts are picked just before they are ripe, hurried into storage with the least possible delay, and kept at 32° F. or even 31° F. until thoroughly cooled right to the centre. These cold pears can be shipped in refrigerated cars to distant markets, or kept in storage for a month or six weeks until the canners are ready to deal with them.

Cold storage has more or less solved the marketing difficulties of soft ripe pears, and has given the Hood River growers such confidence that new acreages are being planted. The pre-cooling of soft fruit such as peaches, strawberries and cherries before shipment by rail has permitted the fruits to reach distant markets in better condition.

The Association has displaced to a large extent the independent merchants in the producing areas, and now trades in much the same way as any merchant would do. Consignments are dispatched to the market in a manner deemed to be intelligent according to the best available information, but no doubt here and there markets occasionally are fed too rapidly and gluts occur. By handling such a large proportion of the output of the district, some attempt at orderly marketing can be made, especially so when cold storage accommodation is available for nearly two-thirds of the whole output.

In many other ways the Association helps. It gives great service to its members in purchasing artificial manures, sprays, boxes to the extent of fully \$900,000 (£180,000), and is able to form a clear estimate of the year's crop and acquaint the railway companies in advance as to the car requirements.

INTRODUCTION OF A PARASITE OF THE WOOLLY APHIS.

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IN 1922 it was decided to explore the possibilities in this country of the Chalcid " wasp " *Aphelinus mali* as a controlling agent for Woolly Aphis or American Blight (*Eriosoma lanigera*). The insect had already at that time received considerable attention in other countries, both in Europe and elsewhere, and its introduction had been attended by a considerable measure of success in the countries adopting it—a success which, as far as reports are available, has continued up to the present time, being most notable in the case of New Zealand, where Dr. Tillyard has elaborated a well-equipped organisation for breeding and distributing the insect.

Notwithstanding the excellent reports of *Aphelinus mali* from elsewhere, it was considered needful to keep an open mind and view with some reserve the possible outcome of an attempt to establish here this insect of American origin. There appeared to be no country in the list of those adopting it where the climate was likely to provide quite so many difficulties, and the question of sufficient hardiness to withstand an English winter was especially in doubt.

Material for the introduction of *A. mali* into this country was received in March, 1923, from France, by the courtesy of Dr. Paul Marchal, of Paris, in the form of dried bodies of aphides containing full-fed larvæ of the parasite. The adults emerging from this original material multiplied at a prodigious rate in captivity on apple trees in pots infested with Woolly Aphis during the following summer, and by 1924 it was possible to consider introductions in the open at various chosen centres.

It will be seen from the following reports that not only were the weather conditions of the past year extremely adverse to the parasite, but coincident with this disability, Woolly Aphis, its host, was in most places abnormally scarce—in some areas even completely absent. In many instances the first few colonies showing tiny clumps of wool, the usual precursers of the infestation to come, completely failed to develop further and as far as this pest is concerned the trees remained clean throughout the season. This condition of affairs was well illustrated at Harpenden, where, apart from parasites bred in confinement for distribution, an introduction was made in the open in an orchard usually heavily infested with Woolly Aphis. Late in the summer

no trace of Woolly Aphis or parasites was discoverable, and it can only be inferred that the parasites perished from lack of material to work upon.

Like most of the Hymenoptera, *Aphelinus mali* is a sun-loving insect, flying readily on warm, still days. The cold, wet and windy weather prevailing during so large a portion of 1924 would militate considerably against its spread in districts where its host occurred in sufficient numbers to enable it to make headway. So much do dull and windy conditions affect the insect that at the laboratory it has been found that in such weather trees in pots upon which are many winged adults can be moved across the open without danger of losing any, the higher the wind the safer being the operation.

Notwithstanding adverse conditions, the results of last season's introductions of *Aphelinus mali* are distinctly hopeful. In Somerset, Devon, Norfolk, and the Isle of Ely, the insect increased and has probably established itself: in some other districts it has not, at least, died out.

The behaviour of the insect during the winters of 1923-4 and 1924-5 has dispelled any doubts that might at first have been entertained as to its ability to endure the English climate. Indeed, it is hardier than might be suspected. In the winter of 1923-4 some late emerged adults in an open gauze-covered cage continued to live without harm while the thermometer was registering 19°F. of frost outside. This is much more than many of the indigenous Hymenoptera (*Ichneumons, etc.*) could endure as adults, so little fear need be felt for the larvæ and pupæ of the Chalcid.

It is probable that *A. mali* failed to exhibit some of its main characteristics during the inclement season of 1924. There is a continuous overlapping of broods, but it is also observable that there are very large emergences at intervals during the summer, when the insects appear in a kind of swarm. Should the day then be still and sunny they fly away in different directions. No such spread occurs in dull weather. There would be few hot days in 1924 to coincide with maximum emergences, and it is therefore likely that the spread of the parasite was very much less than would normally be the case.

Life History.—Perhaps the substance of the reports may be made more clear to those who have not seen previous references to the insect if a few words as to its life-history are given.

The female fly or wasp (the latter designation being nearer to the truth, as *A. mali* is allied to the true wasps whereas it has little relation to the true flies) places her eggs inside the bodies of

Woolly Aphides by means of a specialised piercing organ, the ovipositor. On hatching, the egg produces a legless, flaccid grub which continues to grow by feeding on the internal juices and organs of its host, the Woolly Aphis. By the time the grub is full-fed, the whole of the interior of the aphis is consumed, only the outer shell being left. Unlike many insects, the parasitic grub does not spin a silken cocoon within which to undergo the pupal condition previous to emerging as an adult fly, but continues to lie within the empty skin of the aphis, the latter becoming tough and dry and serving the purpose of a cocoon. Indeed, it has become convenient, though strictly incorrect, to speak of these dried aphis bodies containing larvæ or pupæ of *A. mali* as cocoons.

Shortly after being parasitised, a Woolly Aphis loses its familiar woolly covering—in reality a wax-like secretion—and when containing a full-fed grub or pupa, is quite black, so that it is always readily possible to distinguish the work of the parasite and estimate amongst colonies of Woolly Aphis the extent of parasitisation. When the pupa has become an adult Chalcid within the aphis, and after its integument has become hardened and the " wasp " ready to merge into the open, it bites a way out, so that empty skins can be easily recognised by the hole they contain. Therefore a black and dry-looking Woolly Aphis, if intact, may be presumed almost with certainty to contain a larva or pupa of the parasite.

Several generations of *Aphelinus mali* appear during the year, and there is considerable overlapping. The winter is passed as a larva or grub within the aforementioned dried aphis skin attached to a twig or bough, the pupal condition being attained in the spring shortly before emergence. By cutting off twigs with cocoons attached and fixing them close to colonies of Woolly Aphis in the spring, an easy way of distributing the parasite is found. In this way or as adults later in the season the parasite was distributed to the following centres :—

Seale Hayne, N. Devon ...	cocoons April 30th
Evesham district	cocoons May 6th
Cambridge	cocoons May 12th
Hereford	cocoons May 15th
Kent	cocoons May 17th
East Malling, Kent	adults June 25th
Newport, Salop	adults June 27th
Chichester	adults June 27th
Wisley, Surrey	adults June 30th
Reading district	adults July 4th
Norwich district	adults July 5th
Bangor district	adults July 14th
Long Ashton (Bristol) district	adults July 26th

Comments and Reports on the Distribution.—Mr. Costin, Horticultural Superintendent at *Chichester*, writes, 23rd March, 1925 :—" The small blackened bodies . . . are fairly numerous in the orchard." Cocoons are referred to—the insect seems therefore to have established itself and left a stock for the current year.

Mr. Kent, Horticultural Superintendent, who by arrangement with Mr. Petherbridge introduced the insect into the *Isle of Ely*, reports :—" The colony of *Aphelinus mali* supplied by the Ministry was introduced on 9th May into an orchard near Upwell. Although the remainder of the orchard was sprayed with a carbolineum wash, four trees of Allington Pippin apple, very badly infested with Woolly Aphis, were reserved unsprayed, and remained unsprayed throughout the season. The colony was attached to one of the four trees, and in a few weeks it was noticed that numbers of Woolly Aphides on two of these trees were without their normal wool-like waxy covering, development of the Chalcid larvæ in their bodies apparently preventing the excretion of the wax. By the end of June dead blackened bodies of Woolly Aphides were readily noticeable on two of the four trees, each blackened body showing the small round hole from which the adult Chalcid had emerged. In July dead parasitised Woolly Aphides were observable on all four trees, and small branches from two of the four were placed amongst the branches of trees in other parts of the orchard. In September a few Chalcids had emerged in two other parts of the orchard. In September also it could be seen that one of the four unsprayed trees was almost completely cleared of Woolly Aphis, while the numbers of the pest on the other three trees were very greatly reduced. In the first week of that month I attempted to introduce the Chalcid into orchards at March (2), Wisbech St. Mary, Leverington, and Haddenham, by placing branches from the four trees at Upwell into trees in these places. No Chalcids have emerged from the trees yet in the case of any of these secondary introductions, but I hope that some may be overwintering in aphid bodies on these trees."

" There appears to be sufficient material at Upwell to carry through the winter and give rise to egg-laying Chalcids in the spring, as Woolly Aphides minus the usual wool are fairly plentiful on two of the four trees. The four trees are to remain unsprayed again in 1925, but the remainder of the orchard has again been sprayed with a carbolineum wash."

" The weather in 1924 was, except for a fine, warm period in July, wet and cool, being generally against the development of

the Chalcid. In spite of this the colony has succeeded in establishing itself so far, and should the winter not prove fatal, I anticipate its spread next season somewhat more extensively."

Mr. Massee, East Malling Research Station, *Kent*, states:—" There is only one place in which the parasite can be said to have definitely become established."

Mr. Staniland, *Long Ashton, near Bristol*, reports:—" The colony on arrival was found to contain five living individuals only. These were placed on trees infected with Woolly Aphis in a greenhouse pending the completion of our insectary. Later a few *Aphelinus* appeared and we managed to work up a good stock, consisting of half a dozen small trees well covered. Woolly Aphis has been scarce at Long Ashton until the end of August and beginning of September, when *Aphelinus* was placed out in three places on the plantation. All the pot trees of stocks, except two, have also been placed out in the plantation."

" *Aphelinus* has spread on the trees on which it was actually placed, but I have been unable to detect any spread on to other trees. This would be accounted for by the very small number of days which have not been windy, Long Ashton being a particularly windy place. At the present time there is a fair number of parasitised aphides without emergence holes, and therefore presumably containing hibernating *Aphelinus* larvæ."

" *Aphelinus* has been placed in an orchard at Wiveliscombe, near Taunton, Somerset, and here also there are apparently sufficient hibernating individuals to carry on next season. A small stock was put out at Cannington but has not succeeded in getting a hold."

Mr. Mosley of *Reading* reported that conditions in his district were most unfavourable and that a few isolated cocoons only exhibited the presence of the parasite on 12th February, 1925.

Mr. Goude, Horticultural Superintendent for *Norfolk*, reports:—" The flies were released on the day of receipt, on a tree badly infested with American Blight in a plantation at Dereham. They increased during the summer plentifully, and the reduction in the amount of blight on the tree, and adjoining trees, was noticeable towards the end of the summer. Patches of the blight now appear black in the infested area, and I believe that these black areas are carrying plentiful cocoons of the Chalcid."

Mr. Hodson, Seale Hayne College, *Devon*, reports:—" The site selected for the release of the parasite was a mixed orchard on the Cornish bank of the River Tamar. This orchard lies

within a few feet of the river level in close promixity to other orchards, and has ample evidence of long-standing attack by Woolly Aphis."

"A rather unfortunate factor from the point of view of the complete success of the introduction is the fact that Woolly Aphis has been singularly scarce in the West Country during the past season, this scarcity being attributable to the particularly cold and wet weather experienced during the spring and early summer."

"A number of twigs covered with parasitised aphides were received from Harpenden early in May. The parasites commenced emerging on 10th May, and these were released in the orchard on the 12th. The twigs—which still retained the majority of the parasites—were fastened in two bunches on adjacent trees. These were protected from heavy rains by wire cylinders covered in butter muslin, which were, however, left open at the ends in order not to interfere with the egress of the parasites on emergence."

"The introduction was followed immediately by a week of heavy rain, and on a second visit being paid to the orchard on 22nd May, it was found that emergence was complete, but careful search on and near patches of aphides failed to disclose a single parasite. The orchard was again visited in June and July with similar results. On 21st August, however, several large clusters of parasitised aphides were observed, and numbers of *A. mali* could be found on the wing and resting on patches of aphides. Further adults were released on this occasion."

"A visit was not again paid until 8th October, when adults were again found with ease, and considerable numbers of parasitised aphides were to be observed on trees at some distance from the points of introduction. It remains yet to be seen how the parasite will stand the winter, but given favourable weather it should undoubtedly make good progress in the spring."

"It is hoped that it will be possible to utilise this orchard as a distribution centre for Devon and Cornwall next season, and it is further hoped that a stock will be available in an orchard on Seale Hayne College farm for a more comprehensive study of the parasite's behaviour under field conditions in this country."

Mr. Jary, Harper Adams Agricultural College, Newport, *Shropshire*, reports:—"The adult Chalcids were received on 27th June, most of the insects in the tube having suffered no harm in transit. A few, however, were dead or damaged. The living specimens were liberated in the evening, immediately on

arrival, the tube containing them being supported from a branch immediately alongside a large colony of Woolly Aphis. The tree was a large standard Bramley's seedling."

"Woolly Aphis, which was somewhat late in appearing in numbers in 1924, was then becoming well established in situations occupied the previous year, large galled growths having been formed. The weather had been warm during the previous week but on 27th became much cooler and slight rain fell throughout the afternoon of 28th. Thunderstorms and very heavy rain followed on 2nd and 3rd July."

"Throughout the summer the Chalcid appeared to be established, but making very little headway. Colonies of Woolly Aphis at present on the tree show only a few parasitised members. A small number of larvæ are present and several empty skins of aphides showing exist holes."

"On the whole, I think, in an unfavourable summer, with the amount of Woolly Aphis considerably below the average, the parasite has done little more than maintain itself."

Mr. Goaman, *Hereford*, reports on 29th July, 1924 :—" Fresh emergences from cocoons on the trees at Purley on the 7th July and 18th July respectively. The whole of the original tree is free from Woolly Aphis and the *Aphelinus* has spread to other trees up to 30 feet." On 31st October, 1924, he writes :—" There appeared to be a few overwintering cocoons. In this plantation the Woolly Aphis appeared to migrate at the end of the summer but it is now appearing again. Whether the migration adversely affected the spread of the *Aphelinus*, I cannot say for certain, but I think so."

Mr. Maltby, *Evesham*, reports that conditions in this area were unfavourable, Woolly Aphis failing to develop further when the parasite was introduced.

Mr. Petherbridge, *Cambridge*, also reports :—" The parasite does not appear to have established itself at this centre."

At *Bangor* results were not promising and overwintering cocoons have not been discovered, while at *Wisley* and *Rochester* Woolly Aphis failed to develop.

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INVESTIGATIONS OF SPRING-TAILS ATTACKING MANGOLDS.

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AN attack on mangolds known as "Black Leg" or "Strangle" has been reported from several districts during recent years. Considerable damage has been noted in North Wales, Shropshire, Lancashire, and other areas during 1922-1924. As the name suggests, the characteristic feature of the attack is that of a pinching off or strangling, which often results in the upper portion of the mangold being severed from the root. Bleeding takes place during the attack and causes a blackening at the severed point, thus giving rise to the term Black Leg. (It should be noted that the severing occurs at or slightly above soil level, and not below as in the case of attack by the larvæ of the beetle *Atomaria linearis*.)

This disease has been attributed to several causes, including the attack of wireworm, larvæ of *Atomaria linearis*, *Collembola* (Spring-tails), fungi and bacteria. In this *Journal* for December, 1922, p. 828, it was suggested that spring-tails might be the cause.*

The amount of damage done is variable, but that it can be serious has been shown this year near Bangor, where 25-30 per cent. of the crop was destroyed. Destroyed roots were received at the Laboratory of Agricultural Zoology, University College of North Wales, from Mr. W. J. Gough, manager of the Penrhyn Home Farm, and investigations as to the cause of attack were immediately commenced.

The field in which the attack took place is situated about 200 feet above sea level, having a considerable slope with north-west aspect. The soil is of a heavy nature, and recent continuous rain had resulted in a wet surface. Three acres of the field contained mangolds which had followed oats in rotation, roots having been last grown eight years previously. The varieties, Yellow Globe and Golden Tankard, had been sown on 23rd and 26th May, 1924, respectively, and the crop had been singled and scuffled so that the field was clean. Damage was first noticed by Mr. Gough on 1st July, after which dressings of nitrate of soda were given and the destroyed plants collected and burnt.

* R. Stenton, Pathological Laboratory, Ministry of Agriculture.

Observations on 26th July (by which time the destruction of plants had almost ceased) revealed the fact that the attack was confined in the main to the variety, Yellow Globe, and chiefly to the lower and damper portions of the field. Results of three successive counts of 100 each gave 27, 43 and 35 destroyed plants respectively—an average of 35 per cent.

The usual method of cultivation had been applied to the 1924 crop, thus eliminating the possibility of the trouble being due to any abnormal farm operation. Spring-tails were found in abundance, the following species being obtained: (1) *Bourletiella hortensis*, Fitch (*pruinosus* Tib.); (2) *Isotoma viridus*, Bourlet; (3) *Isotomerus palustris*, Müller; (4) *Sminthurus viridis*, Linn.; (5) *Bourletiella lutea*, Lubbock; (6) *Dicyrtominia minuta*, Fab. Of these, (1) to (4) were abundant, but (5) and (6) were less frequent. The black globular species (*B. hortensis*) was found on every leaf examined, while numbers were present on the roots of mangolds, soil, stones, etc. Both species of *Isotoma* and *Isotomerus* (elongate, slate-coloured, and brown spring-tails) were confined to the roots and the soil. The yellow globular forms (*S. viridis* and *B. lutea*) were present on both roots and leaves. Mangolds were secured and photographed at the various stages of attack as shown in Fig. 1, and in each case spring-tails of the first four species mentioned were found at the point of infection. Three successive counts at individual attacked plants resulted as follows:—

(1) 7 *Isotoma viridis and Isotomerus palustris*, 11 *Bourletiella hortensis*, Fitch, 9 *Sminthurus viridis*; some others escaped.

(2) 21 *Bourletiella hortensis* (observed around the circumference of the root at soil level), 8 *Sminthurus viridis*, 6 *Isotoma viridis* and *Isotomerus palustris*.

(3) 15 spring-tails (various).

Rain fell almost continuously during 27th and 28th July (totalling 1·49 in.), and the observations were made on the latter date during heavy showers. The globular species of *Bourletiella* and *Sminthurus* kept to the under surface of the leaves, while both species of *Isotoma* and *Isotomerus* were very active on the surface of the soil and as many as 12 were counted near a non-affected mangold.

In one instance a singe *Isotoma viridis* was observed feeding on a young mangold of 6 mm. diameter. This spring-tail was observed under a hand lens enlarging for nearly ten minutes (after which the wind blew it off) a hole which finally measured

4 × 4 mm. (Fig. 2 depicts a section through this bitten area). The method of feeding was that of a rasping or gnawing action penetrating deepest at the centre. A similar freshly-cut cavity also appeared immediately above the spring-tail and this measured 6 × 2 mm.

The crop showed a considerable amount of leaf attack, and it was observed that spring-tails of all species were at work feeding on the leaves, resulting in considerable holing. In one instance such a hole measuring 2 mm. was made in a leaf by three *B. hortensis* in about five minutes.

Eradication.—On 29th July control experiments were commenced on the chess-board system, the insecticides used being: (1) A 5 per cent. nicotine sulphate dust (40 per cent. black leaf) equivalent to 2 per cent. pure nicotine, (2) fine air-slaked lime, (3) pyrethrum powder, and (4) a 1 per cent. green tar oil dust. All were distributed by means of a small hand sulphurator.

Further heavy rains fell during the few days following these applications, and observations were made as given below.

(*a*) *Nicotine Sulphate.*—This proved an excellent contact insecticide for the *Isotoma* and *Isotomerus* species, giving 100 per cent. kill, and was used by the writer as a means of collecting them, the insects being gathered with the forceps after dusting. *S. viridis* was also killed, but *B. hortensis* skipped away to parts where the dust had not reached. Under such conditions as prevailed on 29th and 31st July (total rainfall of 0·65 in.) the effect of this insecticide was not lasting, for by 1st August the numbers of spring-tails had again reached those of the control plots.

(*b*) *Lime (fine air-slaked).*—This also was a useful contact insecticide, though not so effective as nicotine sulphate. On 29th July when the plot was evenly dusted with lime the spring-tails skipped about quickly, some being killed, but by 1st August the *Collembola* were observed creeping over the limed surface.

(*c*) *Pyrethrum Powder.*—This was not seen to kill any of the spring-tails, its action being rather that of a repellant. The numbers were lowest on 2nd August, four days after treatment.

(*d*) 1 *per cent. Green Tar Oil Dust.*—An active repellant. Spring-tails of all species moved rapidly away from plants and soil thus dusted. The numbers were lowest on 30th July, after which there was an increase until they attained those of the control on 4th August.

Rapid growth of the mangold crop during this period then minimised the effects of attack, and the field experiments were discontinued. The diameter of the mangolds at this stage was

about 2-3 cm. A final examination was made on 6th August, and showed that *B. hortensis* had practically disappeared, while the numbers of all the other species had considerably decreased. The rainfall for 4th-6th August inclusive averaged 0·45 in. The heavy rainfall throughout the observations undoubtedly affected the results of the experiments.

Observations in the Laboratory.—It was suggested in this *Journal* for December, 1922, that a yellow variety was more susceptible to attack on account of the greater proportion of root visible above soil level as compared with a red variety. With this point in mind the two varieties were examined in the field, but no appreciable difference was noticed during these investigations. The susceptibility of Yellow Globe was so marked that in rows containing both varieties, Yellow Globe plants were destroyed while adjacent plants of Golden Tankard were untouched. Both varieties examined were apparently identical in size, growth, and position of root above soil level.

Variability in thickness of the outer epidermis was next considered as a possible cause for this difference in susceptibility, but microscopical examination revealed no appreciable difference.

The concentration of cell sap was a possible factor, since spring-tails were observed feeding on the cell sap oozing from attacked Yellow Globes. Golden Tankards were then cut and left in position in the rows to allow bleeding to take place, and when observed on the following day numerous spring-tails were seen feeding on the cell sap which had oozed out, showing that no differentiation was made between the actual sap of each variety.

Microscopical examination of cross-sections of both varieties revealed the fact that the amount of orange-coloured stain (carotin) present in the outer epidermal cells of the root of Golden Tankard was much greater than in the case of Yellow Globe, and, further, the colour was deeper, suggesting a higher concentration and the presence of an anthrocyanin. Some nauseous effect of the stain is possibly a factor of considerable importance in the greater immunity of Golden Tankard.

Spring-tail Attack under Laboratory Conditions.—Mangolds were transplanted from the field into a cage in the laboratory, and considerable numbers of spring-tails were introduced; the numbers were reinforced daily, but difficulty was experienced in securing sufficiently rapid root absorption in the loose soil of

the cage, and also in securing the slight leaf transpiration essential for bleeding in such a comparatively dry atmosphere. These plants were examined daily, and the movements of the spring-tails observed. Leaf damage was seen to take place and individuals of *Sminthurus*, *Bourletiella*, *Isotomerus* and *Isotoma* species were all observed to cause perforation of the leaves. Root attack took place (although not personally witnessed) and on examination a week later one of the mangolds had developed a root constriction similar to those noted in the field, and microscopical examination revealed similar bite marks. The experiment was allowed to proceed until 3rd October, when the plants were removed for final examination. Under these largely unnatural conditions growth had taken place mainly in the leaves, all of which showed marked holing. The roots were scarred with markings comparable to the cavity produced by the individual of *Isotoma viridis* on 28th July mentioned on p. 351.

Botanical Examination of Constricted Mangolds.—It was observed that in numerous mangolds collected in the field a constriction occurred at the point of attack (see Fig. 1), and as growth proceeded this constriction became more and more marked. The botanical structure of the mangold is such that growth takes place in a series of concentric cambium rings, thus differing from the general farm root crops. The cambium cells are richest in sugar content and thus more attractive to the insect feeders. Specimens of mangolds which showed this constriction were secured and transverse sections through the constricted areas were examined microscopically. Preserved sections show clearly that the initial bites remove small portions of one of the first formed rings of cambium, and that each successive ring fails to complete its circumference at these points of attack (see Fig. 3). The result of this is that there is formed a crevice or constriction which becomes larger as each successive concentric ring is added, and the final result is fracture and death of the plant. All types of constriction may be noted in a field suffering from attack, differing with the position of the initial damage due to insect (or other) injury.

The work was carried out at the suggestion of Dr. C. L. Walton, Adviser in Agricultural Zoology for North Wales, whose valuable assistance is gratefully acknowledged. The writer is also indebted to Dr. G. H. Carpenter for identification of the *Collembola* (spring-tails) collected, and to Mr. W. J. Gough for information and help in connection with field experiments.

FIG. 1.—Mangolds attacked by Spring-tails, showing the constriction at the point of attack.

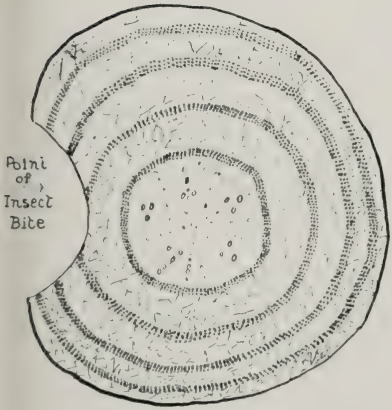

FIG. 2.—Section of Mangold showing point of attack.

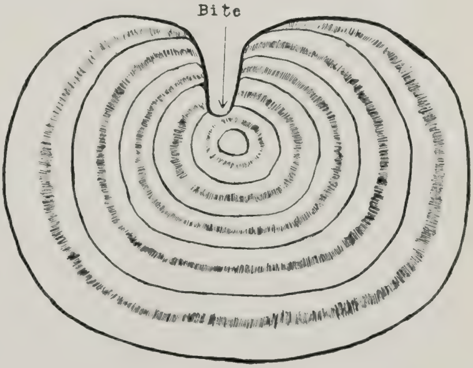

FIG. 3.—Section of Mangold showing the incomplete rings at the point of attack.

LOGANBERRY CULTIVATION.

THE loganberry may best be described as a cultivated form of the American blackberry, *Rubus vitifolius*. It was first introduced into Great Britain about the year 1900, but in the United States it was known to cultivators for nearly 20 years previous to that date, having originated in the garden of Judge Logan, of Santa Cruz, California, in 1881. Once considered to be a cross between the Californian blackberry and the raspberry it is now thought to be a variety only of the former species. Botanically the plant has no fundamental difference from *R. vitifolius*, but the fruit is redder, larger and more juicy, and ripens much earlier. Also, it is very much more prolific.

The loganberry speedily became a popular fruit, its chief value lying in its very marked piquancy of flavour, which serves to enhance the quality of jams made from other soft fruits when mixed with them. Loganberries are also a valuable fruit for bottling and canning, for jelly making, and for mixing with other fruits for tarts, etc. The concentrated juice of the fruit is considered to be superior to any other, and finds a ready sale in bottles. In America a considerable quantity of this juice is produced every year, and is readily disposed of to the manufacturers of beverages, etc.

The fruit of the loganberry is large and tapering, and usually an inch or more in length. It closely resembles a mulberry in appearance. The colour when fully ripe is a dark purplish red, but when picked for market the fruit is nearer the colour of the raspberry. It is very juicy and the flavour is sharply acid and refreshing, being quite distinct from that of any other fruit.

The plant in habit is trailing, with a perennial root-stock from which new canes are thrown up each year to bear fruit the following year.

The loganberry is not grown commercially in Great Britain to any large extent, but the area under cultivation could very safely be extended. The principal centres of production are Kent, Middlesex, Worcester and Hereford, but the total area probably does not exceed 300 acres. In Kent the fruit is found to thrive well in old hop gardens, particularly on the strong, heavy loam of the Weald.

Soil and Situation.—Largely on account of its robust habit the loganberry thrives well on most average soils where there is good depth. It is not so particular as regards soil conditions as the raspberry, and provided good dressings of organic manure can be given it will do well where raspberries fail. It grows well

on the strong heavy loams of the clay, and good plantations are often found on the lighter soils overlaying chalk. Wet, badly drained soils are unsuitable. An important point is to ensure that the canes are thoroughly ripened after each season's growth, and on account of this, districts where wet autumn months prevail are not suitable. Unless the canes are properly ripened the yield of fruit will not be encouraging, and, moreover, hard winters will bring about damage by causing them to die back or die out completely. The crop needs as much sun as it can get.

Propagation.—Unlike the raspberry, the loganberry does not throw up suckers remote from the parent stool, which may be dug up and used for planting fresh ground. New shoots are produced from buds formed on the rootstock only, from which they cannot readily be separated. These shoots will, however, when fully grown, root naturally at the tips and so form a new plant. These tip plants may be produced in an established plantation by covering the tips of fully grown canes with an inch or two of light soil in the autumn. By early spring roots will have formed together with a basal bud, and the plant may then be severed and removed. Nurserymen usually grow on these tip-plants for another year and distribute them as maiden canes.

Another way of obtaining a rapid increase of stock is by root cuttings. Pieces of roots about 4 inches long are employed and should be planted up in the autumn in sandy soil. Also ripe canes may be cut into cuttings and struck in sandy soil in frames.

Seeing that tip-plants can be obtained from an established plantation without harming the canes, growers might well bear this in mind and thus obtain an additional income from the sale of the plants to nurserymen and others.

Preparation of Land.—Unless the land is in good heart, as in the case of old hop gardens, it must be thoroughly prepared by ploughing and cross ploughing, preferably in the autumn. A dressing of farmyard manure, 20-30 tons to the acre, should be applied before the final ploughing. The practice usually followed in preparing land for fruit should be closely observed. Lime or chalk may be necessary, and this is best applied to the land just before planting.

Training and Planting.—A most important question to be decided is the method of training the plants. The trailing growths must be adequately supported if good results are to be obtained. A diversity of systems prevails, but amongst commercial growers

two distinct methods are adopted and appear to answer satisfactorily. From many points of view the staking system, mostly employed with success in Kent, is to be recommended. The plants are set out on the square at 4 ft. to 6 ft. apart in the rows according to the strength of the land, the rows being 6 ft. apart. Each hill is provided with one or two good stout poles about 8 ft. in height above ground, and 2 ft. below ground level. These poles are wired overhead with strong galvanised wire to obtain rigidity. If one pole only is used to each hill the fruiting canes are tied to it with tar twine and the runners, as they grow, are directed along the base of the rows, being tied up in place of the fruiting canes directly these have finished bearing and have been cut away. If two poles are used the fruiting canes are tied to one and the runners to the other alternately. Not more than six canes are allowed to each pole, all others being cut away before they attain any length.

The second system consists of training the growths on an upright wire trellis. This trellis is constructed of stout, durable 7 ft. posts, placed at intervals of from 15 to 20 ft. The posts should go in the ground 2 ft., thus leaving 5 ft. above ground. Lighter strengtheners may be driven in between these, and the end posts should be exceptionally stout and be provided with strainers. Upon this framework stout No. 8 galvanised wire is stretched taut, three, or at the most four, strands being sufficient. The plants are put out against this trellis, at from 8 ft. to 12 ft. apart, and the growths are tied fanwise to the wires. The trellises should be 6 ft. apart. The system answers very well for loganberries, but has one drawback. Owing to the profuse growth of new canes the fruiting canes are apt to become smothered and the yield is affected. It is difficult to see and gather the fruit. Also it is not possible to cultivate the ground both ways as in the case of the stake system. Taking both training systems on their merits, staking is considered to be the better plan, and to give the best results. This system has been largely employed in old hop gardens, the existing poles and wire coming in very usefully for the general scheme. Good leather gloves are necessary for the hands when handling the canes owing to their exceptionally spiny nature. When tying up to poles two workers should operate together, one holding up the canes and the other tying.

Planting is usually done when stock is available, either in the autumn or spring. Tips of canes covered with soil in the autumn will have formed roots and basal buds by the following

April, when they may be severed from the parent cane and carefully planted up in their permanent places, or they may be grown on for a year in nursery beds. If stock can be obtained for autumn planting so much the better. Holes for the plants are opened with a spade, and if a forkful or so of good rotted manure can be given to each hole it will be advantageous.

Pruning.—As explained above the fruit is borne on canes produced the previous season, and therefore it is all to the good if these canes are removed directly they have finished fruiting. There is no advantage whatever in delaying their removal, and it helps the next season's cane considerably if performed early. Also, the grower should recognise that there is no advantage in allowing more canes to grow than are needed. Five or six at the most in the case of stakes and from eight to twelve to a hill on the trellises are considered to be ample. Healthy shoots may attain a length of 15 feet, but it pays to stop them when a convenient length is reached. If lateral shoots are produced it is advisable to spur them back before growth commences in the spring.

After-care of the Plantation.—During the first year or so the land between the rows may be usefully employed for crops of vegetables, etc. Loganberries are shallow, fibrous rooting plants; therefore the land between the rows should be only lightly ploughed or scarified each winter. During the summer horse-hoes set as high as possible should be used to keep down weeds and secure a surface tilth to maintain the soil moisture. The land should receive a dressing of from 10 to 15 tons of dung to the acre each winter to insure good results. In dry seasons the plants can be considerably assisted by employing a mulch such as long stable manure, grass and other green matter.

Gathering and Marketing the Fruit.—Loganberries, unlike raspberries, retain the plug when gathered. If required for dessert purposes, the berries are picked with the "strig" or stalk attached. For ordinary market purposes the fruit should not be dead ripe or it will tend to bruise in picking, and will not travel or keep well. The colour should be a good deep red. For dessert the fruit can be left until it is a rich purplish red, providing rapid and careful transit is available. Loganberries travel and preserve their appearance much better than raspberries, although rather more liable to attacks of mildew in wet weather.

The plants should be picked over every second or third day while the fruiting period lasts. On no account should the fruit

be picked when the plants are wet with rain. In gathering it is best to have both hands free, and this may be arranged by employing trays suspended by a strap round the neck to hold the fruit. The pickers should be instructed to be reasonably careful in handling the fruit, and the use of three fingers instead of two has been found the safest way to avoid bruising. The grower should know beforehand for what purpose his fruit is destined as it is obvious that greater care is necessary with fruit for bottling.

Loganberries commence to ripen early in the summer, normally about the last week in June, and continue with good fortune until the end of July or second week of August.

The fruit is usually dispatched to market in 4 lb. chip baskets, a certain amount, usually dessert fruit of good quality, being packed in 1 lb. punnets in trays holding 12 lb. or 20 lb. Preserving fruit is dispatched either in pecks holding 14 lb. or in tubs, as in the case of raspberries, and usually goes direct to the factories.

The Raspberry Beetle.—This insect is by far the most serious pest of the loganberry, which it seems to prefer even to the raspberry. The damage is done by the beetle maggots (larvæ) which feed within the fruit, greatly reducing its value for market. Not only is the fruit itself injured but the presence of many maggots in a sample prevents its use for bottling and renders its sale difficult for other purposes. Unfortunately no satisfactory means of dealing with the pest has yet been discovered. Perhaps the best measure is to run poultry in the plantation since fowls devour the insect freely in all stages. Some growers have found it worth while to tap or jar the canes periodically while in flower, causing the beetles to fall within reach of the fowls. Under experimental conditions, spraying the open bloom with lead arsenate has given promising results, but it is open to objection, firstly on account of the danger of poisoning bees, and secondly because the length of the flowering period would render several sprayings necessary.

When making a new plantation it would obviously be wise to choose a place as far as possible from raspberries and also to clear out of any adjacent hedgerow any wild brambles, which form the insect's natural food plant. The successful cultivation of the fruit depends greatly on the ability of the grower to control this pest.

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JULY ON THE FARM.

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Grass Land.—At this period a year ago, the outlook indicated the likelihood of abundant pasturage; this year the fields are already beginning to look bare, and unless weather conditions change so as to bring on rapid growth, the pastures will require considerable artificial help to support their present head of stock. Unless the farmer has a crop of lucerne or has prepared for emergencies by growing a breadth of tares or other soiling crop, he has to resort to concentrated foods as a means of supplementing short pasturage. The idea of stimulating the pastures themselves has not been extensively tried in this country, but it seems worthy of consideration.

The only stimulant which could be relied upon to produce an immediate effect on grass at this time of the year is a soluble fertiliser of the nitrogenous class, such as nitrate of soda, nitrate of lime or sulphate of ammonia. British exponents of agricultural science do not generally recommend the use of nitrogenous manures on pasture land, when the object is to effect a durable improvement in the sward and especially to increase the growth of the clovers. It must be admitted, however, that little attention has been given to the possibility of increasing the productivity of fairly good pasture by the application of nitrogenous top-dressings. Indeed, little thought has been given to the question of whether the soil supply of nitrates may be short at this time of the year. The Rothamsted records do not indicate great activity in nitrate production in July; they rather suggest that soil bacteria are rather reduced in numbers at this time.

Certain Continental authorities are emphatic as to the value of nitrogenous top-dressings in pasture management, not only as a means of extending the grazing season at both ends, but also to prevent an excess of spring growth being followed by a period of short keep after mid-summer. Professor Falke, of Leipzig, in his "Wiesen und Weiden," strongly advises the application of nitrogenous manures between the end of June and the end of August; and Professor Warmbold, who carried out an extensive series of experiments at Hohenheim, found that the grazing capacity of pastures was greatly increased by the use of nitrogenous fertilisers, part of which he applied in the summer months.

Haymaking.—Ordinarily haymaking is the principal farm operation in the month of July; but this year, owing to the early start made by many farmers, it is possible that much of the area devoted to the hay crop will be cleared before these notes appear. Mowing was general in the Derby district by 15th June and I know of one field actually being stacked by that date. The crops were light and the leas were in many cases remarkably deficient in clover; but the nutritive value of well-made June hay is beginning to be better recognised, and it is not unlikely that the aftermath of the early cut fields will be needed as soon as it is ready to be grazed. Further south haymaking had begun a week earlier.

In some districts there is room for improvement in the matter of attention to the hay after stacking. As the hay sweats and settles, the roof, however skilfully built, tends to become uneven and requires re-dressing before it is thatched; hence it is hardly practicable to thatch a rick immediately it is completed. But in too many cases the stack is allowed to become "piped" and seriously damaged by rain before the protective covering is laid on, not to mention the cases where thatching is entirely omitted. Thatching is expensive and requires skill; sometimes the stacks cannot be dealt with until after corn harvest, when new straw is available. This difficulty is easily overcome by growing a small area of rye, which may be cut in June and the land sown with turnips. The best solution, however, is a Dutch barn. Farmers find that hay may be carted sooner when it is to be put into a barn, as it does not settle so quickly as it does in stacks; but there are so many other advantages connected with the possession of a good hay shed that they are glad to pay a reasonable return on the capital outlay required in its erection, when the owner is willing and able to make this improvement.

Arable Land.—July is a month in which the farmer's thoughts are directed more towards harvesting than sowing. Winter oats, which in the Midlands were in ear by 15th June, will in the ordinary course be ready for cutting before the end of this month, and wheat may be ripe early in August. It is desirable, therefore, that attention be given to the condition of the self-binders, examining the canvasses, tightening up any loose bolts, and rinsing the bearings with paraffin to remove congealed matter which interferes with proper lubrication.

Marrow-stem kale may be transplanted on vacant land during July, thinnings from an earlier sown crop being used

for this purpose. This crop may also be sown broadcast on clean land in the same manner as mustard, excepting that 5 lb. of seed per acre is sufficient where 20 lb. of mustard would be sown. If top dressed with nitrate, it yields a useful quantity of autumn keep, which may be grazed off by cattle without greater risk than is associated with pasturage.

Having regard to the excellent weed-killing weather during the first half of June, there should be little need for deep grubbing between the rows of mangold and turnip crops in July. The inadvisability of deep inter-tillage after the root fibres have spread between the rows was emphasised in these notes last year. Sugar beet, being of much deeper rooting habit than mangolds and swedes, is probably exceptional in this respect; for on the Continent there is a saying that by deep inter-cultivation the sugar is " hoed into the roots."

The abundance of the eggs of the mangold fly on the under surface of the leaves of the plant during the early part of June presaged severe attacks of the leaf maggot later in the summer. Another mangold pest has also been evident from its effects, causing in certain cases the almost entire loss of what was a good plant. The culprit in these was the Pygmy beetle, which is itself almost invisible, but its work is to gnaw away the soft outer tissues of the root, leaving the plant attached to the ground by a thin black string. In two cases to which my attention was specially called, the land was rather low lying and damp and had been cropped with mangolds for several years in succession. Mr. Roebuck, Advisory Entomologist for the Midland province, states that trouble from the Pygmy beetle is often associated with such conditions of cultivation.

Live Stock.—July is generally considered a healthy month for live stock, not being a time when either food or conditions are changed much. Still, there are ailments such as *mammitis* or *garget*, which affects dry cows and which is difficult to control. Apparently the cause is bacteria, which are present in the udder or gain access to it, but which are unable to invade the tissues until the resistance of the organ has been reduced by a blow or a chill. The *warble fly* may be very troublesome, especially in fields where the cattle have not access to shade, and perhaps " gadding " is in many cases responsible for the previously mentioned ailment. Recent work has shown that the warble fly does not lay her eggs on the backs of the cattle as was formerly supposed but on their heels. Hence it is futile to hope for the prevention of warbles by dressing the backs of

the cattle at this time of the year. Probably access to water is a preventive, and it might be thought that walking the animals through a shallow bath of sheep dip might help to keep the fly away from their legs. The horse bot fly, the sheep maggot fly, stomach worms in sheep, the husk worm and the liver fluke are other parasites of special interest to stock owners this month, as this is the time of the year when either they are most troublesome or they gain entrance to the body of the host.

It has often been observed that cattle will drink polluted water, sometimes even in preference to a pure supply, and as the drinking of bad water is not immediately followed by a visible and acute attack of digestive trouble, there has grown up a widespread impression that water impurities do not cause derangements in the health of cattle. Observations by Mr. A. Levie, F.R.C.V.S., Veterinary Instructor for Derbyshire, dealing with twenty herds have, however, produced conclusive evidence that contaminated water, especially water polluted with sewage, is a very potent cause of chronic ill health and loss in cattle. During the summer months, owing to the smaller and slower flow of water in brooks, the degree of pollution is greater; so that where trouble from this source is suspected, cattle should not have access to fields through which a contaminated stream flows.

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MONTHLY NOTES ON FEEDING STUFFS.

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Milk as a Food for Farm Animals.—Since milk is Nature's food for animals, it has been assumed that milk contains all the elements combined in the right proportions necessary for perfect growth of the young. Experiments have shown that this assumption needs modification, particularly when milk designed for one particular species of animal is utilised as food for another species. It has been demonstrated, for instance, that the milk of cows fed under winter stall conditions is often deficient in those vitamines considered essential to growth. Moreover, calves fed on milk to the exclusion of other foods will eventually die. With humans, long breast feeding is also associated with onset of anæmia. Milk is also deficient in one important element, *i.e.*, iron, and the onset of anæmia is probably associated with this deficiency. The reason why the very

young animal grows successfully during the suckling period is that at birth a sufficient store of material rich in iron is present in the liver to supply its requirements during the suckling period. The deleterious effect of the absence of iron in the milk is consequently only shown when this reserve store is exhausted. Analyses of milks of different species show very wide variation among the species, owing to the fact that the composition of the milk of each species is specially adapted for the efficient growth of that species during the normal suckling period. A glance at the table that follows brings out this fact quite clearly:—

Species.	*Water.*	*Protein.*	*Fat.*	*Sugar.*	*Ash.*	Time to double weight (days).
Man	88·5	1·7	3·3	6·0	0·2	180
Horse... ...	90·6	2·1	1·1	5·9	0·4	60
Cow	87·3	3·4	3·7	4·9	0·7	47
Sheep... ...	80·8	6·5	6·9	4·9	0·9	15
Pig	84·1	7·2	4·6	3·1	1·1	10—14
Rabbit ...	79·5	15·50	10·5	2·0	2·5	6

It will be noticed that the milk of different species varies very considerably in percentage composition, both with regard to protein and fat. The sugar and ash also show considerable variation. A very interesting point also reveals itself when the figures are compared with the time taken for each species to double its weight. It will be noted that low ash and protein percentages are associated with the slowest growth rate, and the quickest growth rate is associated with high ash and protein percentages. Moreover, when the ash is analysed it is found that the relative proportions of ash constituents present agree fairly closely with the relative proportions present in the carcase of the young animal, with the exception of iron as already noted above. Since these relative proportions vary with each species it is not easy to substitute the milk of one species with another, since even though the milk be treated so that the relative percentages of protein, fat, sugar and ash are obtained, the balance of ash constituents will be different.

Having demonstrated that milk is not, after all, the perfect food that one has thought, and having demonstrated that the milk of one species may be quite unsuited to another species, a few observations on the desirability of milk as a food may not be out of place. Milk is a food which is highly assimilable by stock, is easily handled, is very digestible, and contains proteins of high quality, *i.e.*, proteins which contain all the elements for tissue building. In the case of very young stock, therefore,

DESCRIPTION.	Price per Qr.		Price per Ton.	Manurial Value per Ton.	Cost of Food Value per Ton.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv.	Price per lb. Starch Equiv.	Per cen of Digest. Crude Protein
	s. d.	lb.	£ s.	£ s.	£ s.		s.	d.	%
eat, British	—	—	13 5	0 14	12 11	71·6	3/6	1·87	10·2
ey, British Feeding	—	—	10 10	0 11	9 19	71	2/10	1·52	6·5
„ Canadian :—									
No. 4 Western	38/6	400	10 15	0 11	10 4	71	2/10	1·52	6·5
„ „ Feeding	37/0	„	10 7	0 11	9 16	71	2/9	1·47	6·5
„ American	38/9	„	10 17	0 11	10 6	71	2/11	1·56	6·5
„ Danubian	38/3	„	10 15	0 11	10 4	71	2/10	1·52	6·5
„ Karachi	38/6	„	10 15	0 11	10 4	71	2/10	1·52	6·5
s, English, White	—	—	11 3	0 12	10 11	59·5	3/7	1·92	8·0
„ Black and Grey	—	—	11 0	0 12	10 18	59·5	2/6	1·87	8·0
Canadian :—									
No. 2 Western	32/9	320	11 10	0 12	10 18	59·5	3/8	1·96	8·0
Argentine	28/0	„	9 17	0 12	9 5	59·5	3/1	1·65	8·0
Chilian	29/0	„	10 3	0 12	9 11	59·5	3/4	1·78	8.0
ze, Argentine	46/9	480	10 18	0 12	10 6	81	2/7	1·38	7·1
South African	46/9	„	10 18	0 12	10 6	81	2/7	1·38	7·1
ns, English Winter	—	—	10 15	1 9	9 6	67	2/9	1·47	20·1
Chinese „	—	—	11 10	1 9	10 1	67	3/0	1·61	20·1
s, English Maple	—	—	11 7	1 5	10 2	69	2/11	1·56	19·4
Japanese	—	—	24 5†	1 5	23 0	69	6/8	3·57	19·4
. Homegrown	—	—	11 10	0 14	10 16	71·6	3/0	1·61	9·6
i, Egyptian	—	—	11 0	0 14	10 6	75·2	2/9	1·47	7·7
Persian	—	—	11 15	0 14	11 1	75·2	2/11	1·56	7·7
ers' Offals :—									
Bran, British	—	—	6 12	1 4	5 8	45	2/5	1·29	10·9
„ Broad	—	—	8 15	1 4	7 11	45	3/4	1·78	10·9
Middlings—									
Fine Imported	—	—	9 12	1 0	8 12	72	2/5	1·29	12·6
Coarse, British	—	—	7 15	1 0	6 15	64	2/1	1·12	11·5
ards, Imported	—	—	7 7	1 4	6 3	60	2/0	1·07	11·6
l, Barley	—	—	12 5	0 11	11 14	71	3/4	1·78	6·5
Maize	—	—	11 0	0 12	10 8	81	2/7	1·38	7·1
„ South African	—	—	9 17†	0 12	9 5	81	2/3	1·20	7·1
„ Germ	—	—	9 10	0 17	8 13	85·3	2/0	1·07	18·4
„ Gluten Feed	—	—	9 15	1 5	8 10	75·6	2/3	1·20	20·0
Locust Bean	—	—	9 15	0 8	9 7	71·4	2/6	1·34	4·0
Bean	—	—	13 0	1 9	11 11	67	3/1	1·65	20·1
Fish	—	—	19 10	3 17	15 13	53	5/11	3·17	50·0
seed	—	—	22 15	1 8	21 7	119	3/7	1·92	19·4
„ Cake, English 12% Oil	—	—	14 2	1 15	12 7	74	3/4	1·78	25·3
„ „ 10% Oil	—	—	13 7	1 15	11 12	74	3/2	1·70	25·3
„ „ 9% Oil	—	—	13 2	1 15	11 7	74	3/1	1·65	25·3
a Bean „ 6 % Oil	—	—	12 2	2 8	9 14	69	2/10	1·52	38·2
onseed Cake, English 5½% Oil	—	—	8 10	1 12	6 18	42	3/3	1·74	17·6
„ „ Egyptian 5½% Oil	—	—	7 15	1 12	6 3	42	2/11	1·56	17·6
orticated Cotton Seed Cake 7% Oil	—	—	12 17*	2 9	10 8	71	2/11	1·56	—
„ Meal 7% Oil	—	—	11 15	2 9	9 6	74	2/6	1·34	36.3
und Nut Cake 7% Oil	—	—	10 5*	1 13	8 12	56·8	3/0	1·61	42·0
n Kernel Cake 6% Oil	—	—	8 7†	1 1	7 6	75	1/11	1·03	17·1
„ Meal 2% Oil	—	—	8 0	1 2	6 18	71·3	1/11	1·03	17·1
ling Treacle	—	—	7 2	0 8	6 14	51	2/8	1·43	1·1
wers' Grains :—									
Dried Ale	—	—	7 10	1 2	6 8	49	2/7	1·38	14·0
„ Porter	—	—	7 0	1 2	5 18	49	2/5	1·29	14·0
Wet Ale	—	—	0 18	0 8	0 10	15	–/8	0·36	4.8
„ Porter	—	—	0 13	0 8	0 5	15	–/4	0·19	4·8
t Culms	—	—	7 15*	1 11	6 4	43	2/11	1·56	19·9

† At Liverpool. * At Bristol.

—The prices quoted above represent the average prices at which actual wholesale transactions have taken ondon, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage s' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. al value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 75, the valent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this ·24, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the uch calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own The manurial value per ton figures are calculated on the basis of the following unit prices :—N, 11s. 7d ; P_2O_5, O, 2s. 9d.

its use is always justified even though it may prove expensive, since the animal will be given a good start in life at the critical period of its career. A check in the early period of life is difficult and expensive to correct at a later stage, so that money saved by economical feeding at an early stage may be lost later in the endeavour to correct for the stunted growth that occurs later. On the other hand, the feeding of adult stock on milk is wasteful, although it is an advantage to feed by-products of milk, butter and cheese if a cheap source of supply is available.

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FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·38	2 7	71·6	9 5	0 14	9 19
Oats	1·38	2 7	59·5	7 14	0 12	8 6
Barley	1·38	2 7	71·0	9 3	0 11	9 14
Potatoes	1·38	2 7	18·0	2 7	0 3	2 10
Swedes	1·38	2 7	7·0	0 18	0 2	1 0
Mangolds	1·38	2 7	6·0	0 16	0 2	0 18
Beans	1·38	2 7	67·0	8 13	1 9	10 2
Good Meadow Hay	1·38	2 7	31·0	4 0	0 13	4 13
Good Oat Straw	1·38	2 7	17·0	2 4	0 7	2 11
Good Clover Hay	1·38	2 7	32·0	4 3	0 19	5 2
Vetch and Oat Silage	1·38	2 7	14·0	1 16	0 7	2 3
Barley Straw	1·38	2 7	19·5	2 10	0 6	2 16
Wheat Straw	1·38	2 7	11·0	1 8	0 4	1 12
Bean Straw	1·38	2 7	19·0	2 9	0 9	2 18

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PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending June 3rd.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13. 2	13.10	12.12	12 17	16. 7
,, ,, Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12. 5*	12. 5*	12. 5*	12. 5*	(N)11. 7
French Kainit (Pot. 20 per cent.)	3. 2	3. 0	...	2.15	2. 9
,, ,, (Pot. 14 per cent.)	2.17	2.15	2. 5	2,10	3. 7
Potash Salts (Pot. 30 per cent.)	...	...	3.15	3.15	2. 6
,, ,, (Pot. 20 per cent.)	...	...	2.10	2.12	2. 7
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7.10	7. 2	7. 5	2.11
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	11. 5	11.10	4. 9
Basic Slag (T.P. 30 per cent.)	...	...	2.12§	...	...
,, ,, (T.P. 28 per cent.)	2.10§	2. 1‡	...	...	...
,, ,, (T.P. 26 per cent.)	2. 6§	1.14‡	...	...	...
,, ,, (T.P. 24 per cent.)	...	1.11‡	2. 0§	...	...
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 8	1.11
,, (S.P. 30 per cent.) ...	3. 7	3. 2	3. 8	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	9. 0	8. 0	8.10	7.17	...
Steamed Bone Flour (N. ¾, T.P. 60 per cent.)	6. 7†	6. 7†	6. 5	5.10†	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	...	...	13. 0	...	...
,, ,, (N. 9, T.P. 10 per cent.) ..	...	...	...	12. 5	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station. London prices are for 4-ton lots. ‡ F.o.r. Works.

§ Prices include cost of carriage from works to town named, and at Bristol are for not less than 4-ton lots. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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MISCELLANEOUS NOTES.

Poultry in Orchards.

FRUIT growers do not always realise the great value that poultry can be in their orchards and plantations. It is well known that the soil in orchards is frequently impoverished by years of cropping and failure to manure. Poultry evenly distributed will make good the deficiency of manure in a most convenient and economical way. In addition, the poultry and the eggs from them should pay a good return on the capital invested in stock, houses, appliances. and wire-netting, after deducting the cost of food and management.

The best orchards to keep them in are those of standard or half-standard trees; in orchards of bush or pyramid trees they may do some damage to the buds or fruit. The heavy breeds, such as the White Wyandotte, or the Rhode Island Red, are to be preferred, as they are much less likely than the light breeds, such as Leghorns, to fly up into the branches.

To get the best results from the even spreading of manure and the greatest destruction of insect pests, it is best to divide an acre of orchard with wire-netting into five sections, and to place in each section a house to hold 24 birds. If the cost of this equipment is prohibitive, it might be tried first on a small plot, the effect upon the crops observed, and then extended, if justified, as means and opportunity allow.

Ducks may be kept, if preferred, instead of hens; they can be more cheaply housed and can be kept in bounds by two-foot netting. One of the egg breeds should be selected, such as Runners, or Khaki-Campbells. Ducks are quite as good as hens in supplying valuable manure, and are probably nearly as good as hens in the destruction of insect pests, but ducks cannot scratch, and so they are not quite so good at clearing the ground of grubs and weeds. The destruction of insect pests by poultry will sometimes save the entire fruit crop from destruction.

Professor Theobald, of Wye, made an examination of the crop of a White Leghorn chicken. five weeks old, kept in an orchard in Kent, and killed towards the end of June, and found 190 Pear midge maggots, 127 aphides, 12 red ants, 2 tortrix caterpillars, and 1 beetle. In the crop of a Red Sussex pullet, killed on the 30th April, he found 14 leather jackets, 10 fever flies, 2 wireworms, 4 cutworms, 5 beetles, 50 ants, 7 woodlice, 4 slugs, 1 millipede, and 20 larvæ of the winter moth.

Many of the chief fruit pests drop down from the trees as caterpillars, in order to pupate or form a chrysalis in the ground,

and it is at this stage that the hen or duck intervenes. The wingless females of some pests, such as the winter moth, are caught before they climb up the tree. Some fruit farmers go so far as to say that poultry in orchards do away with the necessity for banding and spraying. That is doubtful, but it is at any rate certain that if poultry are kept in orchards larger and better crops of fruit will be obtained than otherwise.

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Culling of Poultry Stocks.

IN order to obtain the maximum profit from poultry, culling from the stock should go on all the year round. It should start right from the date of hatching. The Ministry's poultry advisers say "Do not retain any chickens which are unduly long in hatching out of a batch which has hatched normally: they are the weak ones and will never pay for rearing. Furthermore, cripples should not be retained, and should bacillary white diarrhœa break out amongst chickens, it is far better to kill the whole batch and to avoid running the risk of retaining any which may survive the disease and eventually find their way into the breeding pen." That piece of advice applies to chickens of all ages. It is folly to retain weak birds which may later in life find their way into the breeding pen.

Amongst young cockerels there will always be some which are outstanding, and these only should be kept for stock, and the surplus well fed and disposed of as early as possible.

The trap-nest is by far the est aid to culling, for by its use the individual performance of each pullet may be ascertained. Not only should the numbers of eggs laid be taken into account, but also their size. It is not necessary to weigh eggs daily, but it is a good practice to set aside three regular days in each month for doing this. Three days are necessary if the work is to be thoroughly carried out, as it should then be possible to get two eggs from every bird in lay. Should there be some pullets which are putting up remarkable records but are laying small eggs, or are small birds for the breed, poultry keepers will not be misled into keeping them for breeding purposes. As many eggs as possible should be obtained from them, and they should then be sold.

Where trap-nesting is not possible, there are other means of selecting birds, though the same reliance cannot be put upon them. In the yellow-legged varieties, for instance, those pullets

at the end of the year—presuming that they have been hatched at the right season—which still retain the bright yellow pigmentation in the beak and legs are usually poor layers and should be noted for disposal.

When considering the selection of breeding stock, drastic culling is essential. It should be remembered that the tendency in fowls is always to revert to the small egg, and only birds laying eggs of $2\frac{1}{8}$ oz. and over should be used for breeding, and they should be of good size and typical of the breed they represent. As regards male birds, great care should be used in selecting those only whose pedigree is known, and here again the large-egg factor is the most important point.

Culling should go on all through the year. It may be found when breeding operations commence that some hens are laying a large percentage of infertile eggs, or that the eggs do not hatch well, or, if they hatch, that the chickens are weakly and do no thrive. These hens should be removed.

Whilst culling is necessary, poultry keepers will not be in too great a hurry to dispose of breeding stock at the conclusion of the breeding season. It often happens that room is urgently required for growing stock, and the breeder is tempted to dispose of his breeding stock to make room for them, but in doing this very valuable breeding stock may be lost. It is not until the following autumn and winter when the progeny come into production, that the true value of a breeding pen can be ascertained. This particularly applies to male birds: if put into the proper cockerel boxes extra labour is entailed, but they can always be run with young cockerels.

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Ormskirk Potato Trials, 1925.

THE National Institute of Agricultural Botany wish to extend an invitation to farmers, potato growers and merchants, and agricultural advisory and administrative officers to visit the Potato Testing Station, Ormskirk, singly or in parties between the 20th July and 28th August, 1925. Visitors will be able to see the official tests of some hundreds of new varieties of potatoes for immunity from wart disease. These are carried out at Ormskirk for the Ministry of Agriculture and Fisheries, which certifies the results. The other trials open to inspection include the Lord Derby Gold Medal Trials and Yield and Maturity Trials of the leading immune main crop potatoes. There are also nearly

two hundred demonstration plots of the chief varieties of British and foreign potatoes, including the varieties certified as immune in 1923 and 1924.

Hitherto the annual summer inspection of these trials has been held on a single day, but it has been suggested that visitors would be able to learn more about the trials if they came in smaller parties on different days. To see whether this is the case, the Institute will not arrange the usual inspection this year but will be glad to receive agriculturists on dates convenient to them.

Secretaries of branches of the National Farmers' Union, and others wishing to organise parties to see the trials should write to the Superintendent of Potato Trials, Potato Testing Station, Lathom, Ormskirk, Lancs, suggesting alternative dates. Individual visitors will also be welcome, but they, too, should make arrangements with the Superintendent at least a week in advance of their visit. Ormskirk is conveniently reached by a frequent service of local trains from either Liverpool or Preston.

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The Fream Memorial Prize.

THE Fream Memorial Prize, which is annually awarded by the Ministry to the candidate who obtains the highest marks in the examination for the National Diploma in Agriculture, has been won this year by Mr. Harry O. Hirst, a student of the University of Leeds. The value of the prize this year is about £7 10s., which is to be devoted to the purchase of books.

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Harvest Wages.

THE following Agricultural Wages Committees have made Orders or issued Proposals in respect of special rates of wages for this year's harvest.

ORDERS MADE.

Derby.—Special overtime rates for all male workers employed on the Hay and Corn Harvests, the rate in the case of male workers 21 and over being 9d. per hr.

Dorset.—Special overtime rates for all male workers employed on the Hay and Corn Harvests, the rate in the case of male workers 21 and over being 10d. per hr.

Devon.—Special overtime rates for all male workers employed on the Hay and Corn Harvests, the rate in the case of male workers 21 and over being 10d. per hour.

Hants. and Isle of Wight.—Special overtime rates for all male workers employed on the Corn Harvest only, the rate in the case of male workers 21 and over being 9d. per hr.

Hertford.—Special overtime rates for all workers employed on the Hay Harvest only, the rate in the case of male workers 21 and over being 10d. per hr., and female workers 19 and over $7\frac{3}{4}$d. per hr. N.B.—The Hertford Committee met on 27th June to decide whether to fix special rates for the corn harvest.

PROPOSALS OUTSTANDING.

Cambridge.—Corn Harvest. Male workers 21 and over, minimum rate of 60s. for 63 hours per wk. (excluding Sunday), with overtime rate of 1s. 6d. per hr. Female workers 18 and over, minimum rate 11d. per hr. for 63 hours (excluding Sunday), with overtime rate of 1s. 2d. per hr. The proposal includes less rates for younger workers. Any objections to the proposal must be lodged with the Committee before the 3rd July.

Essex.—Corn Harvest. Male workers 21 and over employed on farms containing more than 60 acres of corn and who work the full harvest period, a bonus of not less than £5 5s. shall be payable to cover all overtime employment. Less rates of bonus are proposed for younger workers. Male workers of 21 and over employed on farms containing 60 acres of corn or less, $10\frac{1}{2}$d. per hr. for harvest work; less rates are proposed for younger workers. Female workers 21 and over $7\frac{1}{2}$d. per hr. for harvest work, with less rates for younger workers. Any objections to the proposal must be lodged with the Committee before 11th July.

Norfolk.—Corn Harvest. Male workers 21 and over who work the full month or the full harvest period a bonus of £12. For male workers who do not work the full period a minimum rate of 29s. for a wk. of 50 hr., with overtime payment at $9\frac{1}{2}$d. per hr. The proposal also includes lesser rates for younger workers. Any objections to the proposal must be lodged with the Committee before the 27th June.

Suffolk.—Corn Harvest. Male workers 21 and over who work the full 24 days or the full harvest period a bonus of not less than £6 3s. 4d. shall be payable to cover all overtime employment; less rates of bonus are proposed for younger workers. Any objections to the proposal must be lodged with the Committee before 4th July.

Yorks, East Riding.—Corn Harvest. Male workers 21 and over, not boarded and lodged by their employer, 1s. 3d. per hr. For special classes boarded and lodged by their employer 1s. per hr. Female workers 16 and over 11d. per hr. The proposal also includes lesser rates for younger workers. Any objections to the proposal must be lodged with the Committee before the 13th June.

Copies of the above Orders and Proposals can be obtained on application to the Ministry.

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Farm Workers' Minimum Wages.

MEETINGS of the Agricultural Wages Board were held on the 26th May, and 15th June, at Gwydyr House Annexe, Whitehall, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from various Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions:—

Derby.—From 22nd June special overtime rate of 9d. per hr. for male workers 21 and over employed on the Hay and Corn Harvests in 1925. Lesser rates for younger workers.

Devon.—From 16th June to 25th March, 1926, minimum rates for male and female workers. From 6th July to 25th March, 1926, overtime rates for male workers, including special overtime rates for the Hay and Corn Harvests. In the case of male workers aged 21 and over the minimum rate is 32s. 6d. per wk. of 52 hr. from 16th June to the 30th Sept., and of 50 hr. from 1st Oct., 1925, to the 25th March, 1926, with overtime rates at $8\frac{1}{2}$d. per hr. on week-days and 10d. per hr. on Sundays, and special overtime rates for the Hay and Corn Harvest at the rate of 10d. per hr.

Hants. and Isle of Wight.—From 22nd June. Special overtime rates of 9d. per hr. for male workers 21 and over, employed on the Corn Harvest in 1925. Lesser rates for younger workers.

Hertford.—From 8th June. Special overtime rates for all workers on the Hay Harvest in 1925. The rate for male workers aged 21 years and over is 10d. per hr., and for female workers aged 19 years and over $7\frac{3}{4}$d. per hr. Lesser rates are provided for younger workers

Stafford.—From 28th June (when the previous Order expires) male workers 21 and over 31s. 6d. per 54 hr., with differential overtime rate of 9d. per hr. Lesser rates for younger workers.

Pembroke and Cardigan.—From 2nd June (when the previous Order expired) to 30th Sept., 1925, male workers 21 and over 30s. for 50 hr. in winter (first Monday in October to last Sunday in February), and 54 hr. in summer, and female workers 18 and over 5d. per hr. for a day of 8 hr. Proportionate rates for younger workers, and differential overtime rates, the latter in the case of adult male workers being 8d. per hr. on week-days, 9d. per hr. first 3 hr. on Sunday, and $10\frac{1}{2}$d. per hr. for subsequent hours on Sunday; and for female workers 18 and over 6d. per hr. on week-days, $6\frac{1}{2}$d. per hr. first 3 hr. on Sunday, and $7\frac{1}{2}$d. for subsequent hours on Sunday.

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The Agricultural Index Number.

THE general level of the prices of agricultural produce was further reduced during May, but the decline as compared with April was small. On the average prices were 57 per cent. above those in the corresponding month of 1911-13, a fall of 1 point on the month but 13 points below the level of January. From

August, 1924, to April of this year the index numbers have been appreciably higher than a year earlier, but in May the increase over 12 months ago was only 1 point.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920 :—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	57
June ...	175	112	68	51	58	—
July ...	186	112	72	53	52	—
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat averaged 4d. per cwt. more than in April, but this increase was relatively smaller than in the base years, and the index figure declined by 3 points to 59 per cent. above 1911-13. Oats showed a relatively sharper increase of 7d. per cwt., while barley declined by 2d. per cwt., the index numbers of both these cereals being comparatively low at 36 per cent. above pre-war. Wheat remained appreciably dearer than in the previous two years, but barley was cheaper than in May, 1924, and oats only 5d. per cwt. dearer.

The index number for milk declined by 3 points to 55 per cent. above 1911-13, the reduction being due to lower prices for May in the Manchester district, owing to some extent to excess deliveries. Butter prices fell by $3\frac{1}{4}$d. per lb. on the month, this drop being sharper than in pre-war years, and the index number declined by 10 points. On the other hand, cheese advanced by 2s. per cwt., and sold at 70 per cent. more than in 1911-13, a rise of 9 points on the month. Eggs were $\frac{3}{4}$d. per dozen dearer than in April, but the index number was reduced from 51 to 48 per cent. above 1911-13, as the rise was not so sharp as in the base years.

Prices of fat cattle have been very steady, average prices per stone dead-weight showing practically no change for some months, but as there was a rise in the spring in the base years the index numbers have been falling slowly. Fat sheep declined 1d. per lb. on the month, but this reduction was no sharper than in pre-war years. Fat pigs were also cheaper—by 8d. per stone dead-weight—and the index numbers fell by 7 and 8 points to

60 per cent. above pre-war. Apart from store pigs which became cheaper, there was little change in the level of prices of store stock.

Prices of old potatoes, after rising each week from the beginning of April, weakened considerably in the second week of May, and there was a further sharp fall in the last week of the month. Over the month, however, the prices averaged $2\frac{1}{4}$ times those of May, 1911-13. Last year's main crop potatoes, which are now practically all cleared, have been sold throughout the season at from 2 to $2\frac{1}{2}$ times pre-war prices. Hay became slightly dearer in May, but this crop continues to sell at practically the same level as in 1911-13. Cabbage rather unusually advanced in price in May, and the index number advanced to 89 per cent. above pre-war, but cauliflowers became cheaper and were at 80 per cent. above 1911-13, a fall of 7 points on the month. Carrots became appreciably dearer, but the rise was not so sharp as usual and this vegetable was little dearer than in May, 1911-13.

Index numbers of different commodities during recent months and in May, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.	1925.			
Commodity.	May.	May.	Feb.	Mar.	April.	May.
Wheat ...	37	38	83	79	62	59
Barley ...	16	46	59	45	38	36
Oats	42	30	42	38	34	36
Fat cattle ...	53	51	53	51	50	49
Fat sheep ...	103	87	100	97	100	100
Bacon Pigs ...	64	29	62	67	68	60
Pork " ...	76	33	60	66	67	40
Dairy cows ...	50	58	50	48	47	48
Store cattle ...	33	42	46	43	39	40
Store sheep ...	98	96	100	104	100	99
Store pigs ...	126	36	48	47	64	55
Eggs... ...	43	40	62	49	51	48
Poultry ...	77	87	56	57	50	55
Milk	63	50	84	82	58	55
Butter ...	40	40	62	58	64	54
Cheese ...	42	77	50	57	61	70
Potatoes ...	—28*	212	144	138	115	124
Hay	41	4	0	—1*	—2*	3

* Decrease.

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Harvest Weather Forecasts by Wireless.

FARMERS and many others will no doubt welcome the news that the British Broadcasting Company has been able to arrange for the broadcasting of a morning weather forecast from their high-power station at Chelmsford at 10.30 a.m., summer time, from 1st July, the work to be transferred later to the high-power station at Daventry as soon as that station is brought into use. The Ministry believes that this forecast will be of real use to farmers in conducting their harvesting operations, and is satisfied that, under present circumstances and conditions, it is not possible to broadcast a morning forecast earlier than 10.30. Although it should be useful to many classes of people, including holiday makers, the forecast will be specially prepared by the Meteorological Office of the Air Ministry for the needs of farmers, and will therefore usually refer to rainfall, temperature and cloud only. As the weather is seldom the same over any large extent of country, different forecasts will be given for different districts. These districts cannot be permanently fixed without making them unduly numerous, but will be chosen each day in accordance with the weather situation. The district to which each forecast will apply will be given in general geographical terms, such as "Central and Eastern England," "Scotland and Northern England." etc. The number of districts for which forecasts are given on any one day is not likely to be more than three, and will always be as few as possible. Each listener should therefore wait until a district is called which includes his locality, and then take the forecast which follows.

The forecasts will apply to the twelve hours after they are issued, that is until 10.30 in the evening. The farmer will, however, generally be as much interested in the possible changes in the weather thereafter, and to meet this need, a short paragraph will follow the forecasts giving what is called "further outlook." This will be a short statement applying to the whole country, and will give a general idea of what changes in the weather are expected. The forecasts and further outlook give the conclusions reached by the Meteorological Office as to the weather to be expected, but do not contain any reasons for reaching these conclusions. These reasons are based, as is well known, on the pressure and wind distribution as shown by the charts prepared in the Meteorological Office. A paragraph added after the further outlook will give a short description in words of the pressure distribution and the inferences which may be

drawn from it regarding the weather. This paragraph will be called the "General Inference."

A word as to the best use which can be made of these special weather forecasts may be desirable. It is not intended that they should replace altogether the farmer's own judgment regarding the future weather. The weather is frequently very local in its distribution, and it would be quite impossible to issue forecasts which would be correct for every locality. The official forecasts should therefore be considered as aids to the farmer in forming his opinion. They should be looked upon as giving the *type* of weather to be expected. The Further Outlook section should prove of much value as a general rule, as it will indicate the direction in which it is anticipated that changes will take place. To those who have a smattering of knowledge of modern meteorology, the General Inference may prove specially informative. We all know that a falling barometer is recognised as an indication of approaching bad weather, while a rising barometer generally indicates clearing weather. These relationships are really based on the weather associated with cyclones and anti-cyclones, and if one knows where the cyclones are situated, the movements of the barometer and changes in the weather can be interpreted with greater confidence.

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Agricultural Shows.

A FEW words on agricultural shows in general and the Royal Agricultural Show in particular may be of interest to many farmers and also to others of the general public. The "Royal" Show this year takes place at Chester from 7th to 11th July. During that time Chester will be the "Mecca" of the farming community of this country. It is hardly sufficiently realised how gigantic an undertaking the Royal Show has become. It is the common meeting-place once a year of all that is best in agriculture. The animal exhibits are the masterpieces of the breeder's art, the agricultural machinery is the last word in thorough-going British excellence—to say nothing of the many useful foreign exhibits, and the horticultural exhibition is usually of a most interesting and instructive character. In addition, there are exhibits of all kinds of agricultural produce, dairy, poultry, and so on, and of agricultural requirements, seeds, fertilisers, etc., and agricultural accessories. There are competitions in horse-shoeing, demonstrations of butter and cheese-making, with lectures on

them and on dairying and bee-keeping, whilst all the time judging of cattle, horses, ponies, pigs, and poultry, is going forward under the control of the greatest authorities in the country. The whole comprises a very great show indeed, requiring exceptional powers of organisation and understanding of agriculture in order to be what it is, always an assured success. This year the show ground covers no less than 160 acres.

It may be added that short addresses on the Ministry's dairy exhibit will be given daily in the Ministry's pavilion, and all interested in dairying are invited to attend.

It will be interesting to look for a moment at the beginnings of such shows. They can be traced back for more than a century, when Sir John Sinclair, a President of the old Board of Agriculture, said in a speech which he made after the second show of the Highland and Agricultural Society in 1823 :—

"I have long wished to see meetings assembled . . . . for promoting the improvement of our live stock, and I am happy to find that . . . . they have commenced . . . . . with so much probability of success.

"Such meetings are of great use in various respects; they are the means of circulating valuable information, they excite a spirit of improvement, and much advantage is derived from the discussions which they occasion, and from the opportunities which they afford of viewing the various descriptions of stock which a country possesses, and comparing their respective properties and defects. A Bakewell or a Culley, by great skill, ability and perseverance may do much in ameliorating any particular breed, but the improvement of the general stock of a nation can never take place without such meetings as the one we have this day witnessed."

These observations of 1823 hold as good in 1925. There are now, of course, many large agricultural shows, and a long series of smaller ones up and down the land, and they all serve the excellent purpose which Sir John Sinclair pointed out, of showing the best examples of farm produce for the emulation of the farmer. They also serve to inform the public of the importance of agriculture. A century ago that was not so necessary, for in 1801 our population was only 9 millions, most of whom were resident in the country. We have now, however, become mostly town-dwellers, and according to the last census figures, over 30 of our 38 millions are dwellers in the towns, and under 8 millions, or only one-fifth, in rural areas.

Number and Declared Value of Animals Living, for Breeding, Exported from Great Britain and Northern Ireland in the three months ended March, 1925, compared with the corresponding period in 1924.

(From Returns supplied by H.M. Customs and Excise).

Country to which Exported	Jan. to March, 1925		Jan. to March, 1924	
	Number	Declared Value	Number	Declared Value
CATTLE		£		£
Argentina	137	34,667	11	4,025
Denmark	29	1,260	0	0
Uruguay	24	4,796	6	765
Irish Free State	1,028	17,018	693	11,031
India	10	355	1	13
Ceylon	3	230	0	0
New Zealand	0	0	22	1,535
Union of South Africa ...	20	1,850	14	1,100
Rhodesia	2	120	0	0
Kenya Colony	16	966	0	0
Other Countries	9	800	5	161
Total of Cattle	1,278	62,062	752	18,630
SHEEP AND LAMBS				
Argentina	245	7,099	93	1,793
Peru	90	1,156	6	203
Uruguay	32	975	17	375
Irish Free State	79	248	38	130
Union of South Africa ...	25	326	21	230
Kenya Colony	9	172	0	0
Other Countries	5	78	1	100
Total of Sheep and Lambs	485	10,054	176	2,831
SWINE				
Argentina	6	115	11	498
Belgium	30	200	0	0
Egypt	0	0	3	60
France	5	34	7	136
Germany	6	397	0	0
Japan	0	0	6	202
Peru	5	95	0	0
Irish Free State	119	533	115	183
India	0	0	5	100
Union of South Africa ...	4	90	3	80
Falkland Islands	0	0	14	134
Other Countries	7	167	0	0
Total of Swine	182	1,631	164	1,393

Foot-and-Mouth Disease: Withdrawal of Restrictions.

FROM 1st January, to 7th May, 1925, 21 outbreaks have occurred in nine counties, involving the slaughter of 784 cattle, 349 sheep and 560 pigs, and the payment of £30,452 in compensation.

The Minister has issued an Order the effect of which is to withdraw as from 4th June all general restrictions imposed by the Ministry in connection with the outbreaks of foot-and-mouth disease which occurred in Cheshire, Northants, and Warwickshire on the 5th, 6th and 7th May respectively.

There are now (25th June) no general restrictions in connection with foot-and-mouth disease in force in any part of Great Britain for the first time since the widespread outbreak which commenced in August, 1923.

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NOTICES OF BOOKS.

Gold Coast Plant Diseases.—(R. H. Bunting and H. A. Dade. The Crown Agent for the Colonies, 4, Millbank, Westminster, London, S.W.1 Price 6s., postage 4d.) "In a country where agriculture is almost entirely in the hands of a primitive people and mycological effort in the feeble stage of infancy, an initial work of a general nature on the subject of plant diseases can be little better than a notebook. Such is this; and it is published with an invitation to all local observers to consider it as a nucleus to which any addition from them will be welcomed." This extract from the Preface fairly indicates the nature and scope of the present modest book of 124 pages. It opens with a clearly written elementary account of what is meant by disease, of the symptoms of disease and of the various causes of disease, including those of an inorganic nature and those due to parasites, both animal and vegetable. Special attention is given to fungus diseases; and the nature, mode of life and means of dissemination of fungi are concisely dealt with. Measures of control are discussed, including control by legislation; and the importance of intelligent, public-spirited co-operation in regard to such control is insisted upon.

The second and third chapters are devoted to diseases of Cocoa, chapter 4 to various diseases of other permanent crops, such as Coffee, Cola, Rubber, Citrus, Palms, etc., whilst chapter 5 covers the diseases of annual plants, such as beans, cassava, cotton, rice, tobacco, and several others. The descriptions of the diseases are set out in clear, succinct terms, and the causative organisms are dealt with in not too technical a fashion. Four clear and boldly printed coloured plates illustrate three serious pod diseases and the "White Root" disease of cocoa respectively. In addition, twenty-one plates of excellent half-tone illustrations of many of the diseases dealt with in the text,

printed on art paper, are provided; and they add very considerably to the value and usefulness of the book. From a perusal of chapter 5 on the local legislative measures which have been found necessary to protect crops (especially the cocoa crop) from losses due to diseases, it will be seen that the difficulties with farm owners and others are considerable. Apathy seems already to have resulted in considerable loss of potential wealth, and persistent neglect will eventually lead to disaster. As an aid to removing this apathy and as a means of spreading important knowledge concerning the diseases which have to be fought and the best methods of combating them, this book should serve a very useful purpose. In the concluding chapter 7 there is given a list of fungi collected in the Gold Coast Colony and its Dependencies, with notes on localities and substrata on which they were collected. This will serve to make the book of interest to all who are concerned with mycology in tropical countries. A glossary of the relatively few technical terms employed, as well as a good index, is supplied, while in order to practice to some extent what it preaches the book has been bound with a solution which renders it impervious to the ravages of insects.

The British Goat Society's Year Book for 1925 (issued by the Hon. Secretary, 10, Lloyd's Avenue, E.C.3; price 1s. 6d.) contains much interesting and valuable information. The Honorary Secretary, Mr. Thomas W. Palmer, contributes a foreword in which he refers to the practical immunity of the goat from tuberculosis, citing in this connection statistics which show that only 0.091 per cent. of the goats slaughtered in Holland during the period 1911-1920 were found to be infected with the disease. Encouraging messages from the President, the Earl Bathurst, and from the Chairman of the Committee, are followed by a number of articles on matters of interest to goat-keepers. Among these Mr. J. A. Caseby gives his views on "Tethers and Tethering"—always a vexed question where goats are concerned; Mr. J. L. Whytehead writes on the "Stud Goat Scheme"; Miss D. G. Saker on "Goats' Milk Cheese," and Lady Helen Graham has a useful paper on "Goat Breeding."

The scientific aspect of goat-keeping is represented by chapters dealing with such subjects as "Proteins," by J. C. Urquhart; "Rickets," by F. H. Stainton; "Horn Inheritance in Goats," by C. J. Davies; and "Mendelism and the Goat Breeder," by S. A. Asdell. Hitherto little has been known of inheritance in goats, but the last-named writer indicates that investigations are in progress which, it is hoped, will have important results for the goat-breeder. Dr. Wright gives some striking examples of the beneficial effects of goats' milk as a food for infants.

Dr. Crew contributes some "Notes on the Genetical Aspects of Fertility and Sex Ratio," while F. Knowles and J. C. Urquhart collaborate in providing some valuable "Notes on the Composition of the Fat of Goats' Butter." There are 180 pages of letterpress, and over 40 well-produced illustrations, among which may be mentioned a photograph of Didgmere Dulcie, whose record milk yield of 4,187 lb. in 311 days gives some idea of the possibilities of the goat as a milk producer. Goat-keepers will find this book a most useful and interesting compendium of information.

An Introduction to Sexual Physiology.—(F. H. A. Marshall, F.R.S. London: Longmans, Green & Co., 150 pp. and Index. Price 7s. 6d.) This handbook deals with a number of subjects which are of importance to farmers. It is a remarkable fact that the ordinary curriculum of the Agricultural Colleges rarely includes Animal Physiology, and never that important technical aspect of the subject with which this book deals. The modern curriculum for a degree in agriculture still adheres to the fashion set by Prof. Wallace in Edinburgh fifty years ago: he did not include physiology in his classic curriculum, and, although the sciences bearing on agriculture have since received many recruits, sexual physiology has not been one of them, except at the school to which the author is attached. The stock-raising interest, however, in which horse-breeding is included, easily occupies the first place, economically, among the farming industries of this country. We can confidently recommend this text-book to everyone interested in animal breeding, as all stock breeders must be. The general ignorance that prevails regarding the fundamental facts of reproduction is remarkable: here will be found every conceivable detail lucidly explained and illustrated. The author is the leading authority on the subject in this country and it is fortunate that he has devoted so much of his time to experiments with farm animals. His investigations on the pig (with the late K. J. J. Mackenzie as collaborator) are well known, and much light has also been thrown on fertility and sterility of the cow and the ewe. These and other matters are treated in this admirable text-book. He requires no excuse for concluding his treatise with a statement of his views on Eugenics, for he is entitled to speak with authority.

Cattle Breeding: Proceedings of the Scottish Cattle Breeding Conference.—(Edited by G. F. Finlay, Ph.D. London: Oliver & Boyd. 12s. 6d. net.) Just before last year's Highland Show a Scottish Cattle Breeding Conference was held in Edinburgh, and this volume is a record of its proceedings. The conference was attended by many of the most eminent scientists and students of animal husbandry in Great Britain and Ireland, and delegates came from the Dominions, the United States and the Continent. A large number of papers, most of which were followed by illuminating discussions, were read. The great variety of the problems which confront the breeder naturally led to a wide divergence in the subjects of the papers; it is a little to be regretted that the volume of the discussions which took place has prevented their inclusion in addition to the papers. It has also been found necessary to edit the papers with a view to economy of space.

The papers have been classified under three headings:—(1) Scientific Aspects of Cattle Breeding; (2) Reviews of Cattle Breeding Investigations; and (3) Reviews of Cattle Breeding in various Countries; but it is obvious that, whatever aspect of the breeding problems is attacked, most of the papers necessarily deal with "inheritance" as applied to some particularly desired characteristic. Part 3 deals with the rule of thumb methods adopted by practical men, who are actively engaged in large scale production all over the world, and from that point of view should be of most interest to breeders in Great Britain. Parts 1 and 2 detail some of the results obtained by scientific investigation, which are applicable to the practical problems of cattle husbandry, and a study of these sections should prove helpful to all classes of the breeding community.

SELECTED CONTENTS OF PERIODICALS.

Agriculture, General and Miscellaneous.

Some Aspects of Danish Agriculture, *R. Weatherall*. (Jour. Brit. Dairy Farmers' Ass., xxxvii (1925), pp. 47-66.) [63(489).]

Sources of Industrial Alcohol (with bibliography and index to plants and subjects), *J. H. Holland*. (Kew Bull. Misc. Information, 1925, No. 5, pp. 193-216.) [663.5; 63.349.]

Economics.

An Agricultural Census, *R. J. Thompson*. (Jour. Roy. Statistical Soc., vol. 88, pt. 2, March, 1925, pp. 185-220.) [311.]

Wholesale Prices of Commodities in 1924: The "Statist's" Index-Numbers, in continuation of Mr. A. Sauerbeck's Figures. (Jour. Roy. Statistical Soc., vol. 88, pt. 2, March, 1925, pp. 260-278.) [338.5.]

Leisure Time Occupations in the Country, *M. Beaufreton*. (Int. Rev. Agr. Econ., III (New Ser.), 1. Jan.-Mar., 1925, pp. 3-27.) [30.]

Home Colonization in Germany, *F. J. Rohr*. (Int. Rev. Agr. Econ., III (New Ser.), 1, Jan.-Mar., 1925, pp. 28-72. [325; 333.5(43).]

The Allotment Movement in Scotland during the War, *F. L. Tomlinson*. (Int. Rev. Agr. Econ, III (New Ser.), 1, Jan.-Mar., 1925, pp. 73-88.) [333.38(41).]

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NOTES FOR THE MONTH.

British Breeds of Live Stock.

The Ministry has published a fourth edition of its handbook "British Breeds of Live Stock" (Miscellaneous Publications No. 7, obtainable from the Ministry, 10, Whitehall Place, London, S.W.1, price 3s. 6d. net, post free). This handbook was first published in 1910, and is a useful and reliable guide to intending purchasers both in this country and abroad who desire to obtain British live stock of any particular breed and qualification.

The volume contains a detailed account of the characteristics of the British breeds of horses, cattle, sheep and pigs, and a brief history of the origin of each breed, together with useful information upon the uses of the breed, its value for crossing, the various countries overseas in which it has been established, and from which there is a demand for live stock.

This information is supplemented by over 90 photographs of specimen animals. A complete list of breed societies and a note of the principal places of public sales, exhibitions and shows in this country are also included, together with particulars of average prices of different classes of animals.

While the handbook is of considerable value to those interested in the export of British live stock, the Ministry would commend the publication to the notice of all farmers who wish to improve the standard of their herds from both a commercial and breeding point of view, by the introduction of the most suitable type of animals for their purpose.

* * * * * *

Economic Resources of Canada.

In the summer of 1924, the Ministry learned that Sir Henry Rew, who was visiting Canada in connection with the meeting of the British Association at Montreal, would be willing to make a general inquiry, so far as was possible within the limits of a short visit, into the agricultural resources and output of Canada in relation to the food supplies and agri-

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cultural production of Great Britain. Sir Henry Rew was therefore invited to make a Report on these lines, both on account of the intrinsic interest of the subject and also in view of its direct bearing on the investigations which the Ministry are conducting into agricultural economic questions and methods of marketing.

The Report, which extends to 128 pages, has now been published—Economic Series No. III, Economic Resources of Canada, by Sir Henry Rew, K.C.B., price 1s. 6d., postage $1\frac{1}{2}$d., obtainable direct or through any bookseller from H.M. Stationery Office, Adastral House, Kingsway, W.C.2, and Manchester, Cardiff and Edinburgh.

* * * * * *

Tuberculosis Order, 1925.

FOR some time past, the Government has had under consideration the question of reviving the Tuberculosis Order of 1914. After consultation with the Ministry of Health, the Ministry of Agriculture has issued an Order containing provisions similar to those of the 1914 Order. The new Order comes into force on 1st September next, that being the date on which the Milk and Dairies Consolidation Act, 1915, in England and Wales, and the Milk and Dairies Act, 1914, in Scotland, will take effect. Both these Acts prohibit the use, for the production of milk, of any cow which is giving tuberculous milk or is suffering from tuberculosis of the udder or tuberculous emaciation. The Order will compel the slaughter of all such cows and any other bovine animal which may be suffering from tuberculous emaciation or from a chronic cough and showing definite clinical signs of the disease.

The owner will be required to report to the police any case of a cow suffering from indurated udder or other chronic disease of the udder, as well as any bovine animals suffering from the other above-mentioned forms of tuberculosis. Veterinary practitioners who find such cases amongst animals which they visit in the ordinary course of their practice are also required to report the fact to the local authority. Animals found affected, after full veterinary inquiry, will be slaughtered and compensation paid at the rate of three-quarters of the market value, if found to be suffering from non-advanced tuberculosis, and one-quarter if affected in an advanced form, subject to a minimum payment of 45s. An important provision in the Order is to prohibit the landing of any bovine animals from Ireland, Canada

or elsewhere which are affected with tuberculosis. Any such animals landed in contravention of the Order will be slaughtered in the landing places without compensation. The expenses of carrying out the Order will fall upon the local rates, but a Bill is at present before Parliament empowering the Ministry to refund out of the Exchequer three-quarters of the amount paid by local authorities in compensation for slaughtered animals.

The new Order represents the most that is practicable at the present time in the direction of securing the eradication of bovine tuberculosis, and, in contributing to the production at the source, of a milk supply free from bovine tubercle bacilli.

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Committee for Tests of Agricultural Machinery.

THE Right Hon. Edward Wood, M.P., Minister of Agriculture and Fisheries, has appointed a Committee to supervise, on behalf of the Ministry, the conduct of tests of agricultural machinery.

It consists of the following :—

Mr. W. C. Dampier Whetham, F.R.S. (*Chairman*).
Mr. Harry German.
Mr. J. H. Hyde, of the National Physical Laboratory.
Mr. L. A. Legros, O.B.E., M.I.M.E.
Mr. B. J. Owen, D.Sc., Director of the Institute of Agricultural Engineering, Oxford.

The duties of the Committee will be :—

(*a*) To consider all applications made to the Ministry for tests of individual machines and inplements;

(*b*) To recommend, where no scale has been laid down, the fees to be charged;

(*c*) To formulate details of individual tests;

(*d*) To recommend the Institutions at which, and the persons by whom, individual tests are to be conducted; and

(*e*) To draw up certificates and reports for approval and issue by the Ministry.

In cases where special knowledge is required for tests, or particular forms of test, of any class or classes of agricultural machine or implement, the Committee may for the purpose of such tests, co-opt one or more additional members.

The Secretary of the Committee is Mr. P. Barker, of the Ministry of Agriculture and Fisheries.

Prosecutions under the Agricultural Wages Act.

THE Agricultural Wages Act imposes on the Ministry the duty of securing the proper observance of the Act, and with this object in view two prosecutions were recently instituted by the Ministry. In one case at Epping, Essex, the employer was charged with paying a worker in agriculture at less than the minimum rate of wages prescribed by Orders made under the Agricultural Wages Act, and the Bench imposed a fine of £6 and ordered the employer to pay court fees and the arrears of wages, which amounted to nearly £12. The second case involved a similar charge against a farmer at Brigg, Lincolnshire, and the Bench in this case imposed a fine of £1 and ordered the employer to pay costs and arrears of wages.

* * * * * *

Ministry's Research Exhibit at Wembley.

THE Ministry's exhibits dealing with agricultural research, staged in the Pavilion of H.M. Government at the British Empire Exhibition, have more than once been the subject of a note in this *Journal* (see May, 1925, p. 103, and June, 1925, p. 194). Small changes in the arrangement of the exhibit have recently been made in order to effect improvements, and a new exhibit of preserved fruit, supplied by the Fruit and Vegetable Preservation Research Station at Campden, has been added.

A word may be said as to the nature of the exhibits in question. The Ministry is not blind to the fact that, given different conditions, more space and more liberal financial assistance, an agricultural exhibit of quite another character would not only have been more desirable but could have been organised. It is to be remembered, however, that Great Britain is not a food-exporting country, but a food-buyer on the grand scale. For this reason alone a big display of home produce is hardly called for in the same way that it is in the case of the great Dominions—whose main objects must necessarily be to demonstrate what they can produce and the attractive surroundings in which it is produced, and thus secure business for their producers. From the outset, therefore, it was felt that the most appropriate type of exhibits which could be arranged, taking into consideration the space and funds at disposal, would be a series dealing with the main features of agricultural

Photo by] [*Topical Press Agency.*

FIG. 1.—The Ministry's Pavilion at the Royal Agricultural Show, July, 1925.

research, and the plan adopted was endorsed by an informal committee which met to consider the question before the Exhibition opened in 1924.

A descriptive account of the exhibits is given in a Guide which has recently been issued and which can be obtained direct from the Ministry.* Visitors to Wembley who propose to see the agricultural research exhibits should obtain this Guide in advance. When seeing the exhibits visitors who require any further information should consult the Guide-Lecturer, Dr. G. F. Finlay, who will gladly give every help in his power. Parties of farmers or students may make advance arrangements to be conducted round the Ministry's research exhibits, so that they may make the fullest use of them. Correspondence to this end should be addressed to *Dr. G. F. Finlay, Ministry of Agriculture Gallery, Pavilion of H.M. Government, British Empire Exhibition, Wembley.*

* * * * * *

The Ministry's Exhibits at Agricultural Shows.

A NOTE on the Ministry's agricultural research exhibit at Wembley is given above. It may usefully be added that the Ministry also exhibits at a number of the larger agricultural shows, and has already this year sent exhibits to the Devonshire Show at Plymouth (12th-14th May), the Bath and West Show at Maidstone (28th May-2nd June), the Three Counties Show at Hereford (9th-11th June), the Lincolnshire Show at Grantham (24th-26th June), the Royal Agricultural Society's Show at Chester (7th-11th July), the Royal Isle of Wight Show at Newport (16th July), and the Yorkshire Show at Bradford (22nd-24th July).

It may be said that the large number of visitors to see the Ministry's exhibits, and the interest displayed, have been distinctly encouraging, showing an increasing desire to learn more about the directly scientific aspects of farming, with the object of applying them to the business of food production. In general the exhibits deal with plant breeding, seed testing and weeds, apple packing, rat destruction, fruit preservation, poultry and rabbit keeping, bee-keeping, rural industries, plant pests, improvement of grass land, and clean milk production. The Ministry's publications are also strongly represented, and on sale.

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* Guide to the Exhibit of the Ministry of Agriculture, British Empire Exhibition (33 pages), 1925, price 3d. (post free).

This season the Ministry has been enabled, by means of a special grant, to add an exhibit devoted to dairying, illustrating the main directions in which dairy farmers are being assisted by education and research at the present time. The exhibit, which has attracted much attention, was prepared with the assistance of dairying authorities, particularly the National Institute for Research in Dairying, Reading. A part of it was set aside for a demonstration of the food value of milk, displayed by the National Milk Publicity Council. At the Royal Show a further innovation was the giving of short addresses of about a quarter of an hour's duration four times daily, on subjects of special interest to dairy farmers, and bearing on the exhibit. The lecturers were Dr. Stenhouse Williams, Mr. James Mackintosh and Capt. J. Golding (National Institute for Research in Dairying), Capt. F. J. W. Thornycroft and Mr. P. A. Mytton (Ministry of Agriculture and Fisheries), Mr. R. Boutflour (Agricultural Organiser for Wiltshire), Miss Davidson (National Milk Publicity Council), Mr. W. A. C. Carr and Mr. D. M. Smillie (Reaseheath Farm Institute, Cheshire).

At the Royal Show the Ministry's Pavilion (see photograph) was visited by H.M. the King, who was conducted by Sir Gilbert Greenall (President of the Royal Agricultural Society), and the Rt. Hon. E. F. L. Wood, M.P. (Minister of Agriculture and Fisheries).

Other shows at which it is proposed that the Ministry shall exhibit this year are the Royal Welsh Show at Carmarthen (5th-7th August), the Imperial Fruit Show in London (30th October-7th November) and the Fat Stock Shows at Norwich, Birmingham and Smithfield in November and December.

* * * * * *

The Agricultural Index Number.

THE general level of the prices of agricultural produce was again reduced in June, thus continuing the fall which has taken place each month since January. On the average prices were 55 per cent. above those of the corresponding month of 1911-13, against 57 per cent. in May. The decline was due to the sharp fall in potatoes and the lower prices of fat sheep and pigs. This is the first month since July, 1924, in which the index number has been lower than a year earlier. In June last

year the general level of agricultural prices was 58 per cent. above pre-war, the lower price of potatoes this year being more than sufficient to account for the difference on the year.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	57
June ...	175	112	68	51	58	55
July ...	186	112	72	53	52	—
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

The quantities of old potatoes held over to the end of the season were rather heavier than was necessary, and a sharp fall in prices set in during the fourth week of May, but even so the average level of prices during June was 76 per cent. above pre-war. Wheat and oats were 3d. per cwt. dearer on the month, but the price of wheat has now been falling for two or three weeks. The index number of wheat rose by 3 points to 62 per cent. above pre-war, and that of oats advanced from 36 to 38 per cent. above 1911-13. Barley dropped 2d. per cwt., but this fall was relatively less than is usual in June, and the index number rose by 2 points. As compared with June of last year, wheat and oats are dearer but barley is cheaper. Hay remains very steady at practically pre-war prices.

Fat cattle reached their maximum price for the year in the first week of June and have since become cheaper. Over the month they averaged slightly less than in May, but the decline was rather smaller than in the basic years and the index number rose by 1 point to 50 per cent. above 1911-13. The reduction of 1d. per lb. in the average price of fat sheep was, however, much sharper than in 1911-13, and the index number declined by 7 points to 93 per cent. above pre-war. Fat pigs also showed a relatively sharper reduction than usual, and the index figures dropped from 60 per cent. above pre-war in May to 54 per cent. for baconers and 53 per cent. for porkers. As compared with a year ago fat cattle are rather cheaper, fat pigs appreciably dearer, while sheep are selling at similar prices.

Dairy cattle became cheaper in the early weeks of June, but with the pastures becoming rather burnt the demand improved latterly, and over the month there was little change in the index number. The recent shortage of grass has affected the demand for store cattle, but earlier in the month prices were higher than in May and the index number shows a rise of 3 points to 43 per cent. above pre-war. Store sheep were relatively dearer than in May, the decline in prices being less than in the basic years, while the index number for store pigs remains unaltered although prices were reduced slightly.

Contract prices for milk were the same for June as for May. Butter averaged ½d. per lb. less on the month, but the index number advanced 3 points to 57 per cent. above pre-war, whilst with only a trifling increase in the price of cheese the index number rose by 8 points to 78 per cent. above 1911-13, there being an appreciable reduction in June, 1911-13. Eggs advanced 1½d. per dozen on the month, and at 52 per cent. above pre-war were relatively dearer than in June last year.

Gooseberries have sold at fairly high prices, averaging during June 81 per cent. above pre-war, and strawberries have averaged 54 per cent. above pre-war.

Cabbage realised 78 per cent. and cauliflowers 76 per cent. above pre-war.

Index numbers of different commodities during recent months and in June, 1923 and 1924, are shown below :—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

Commodity.	1923. June.	1924. June.	1925. Mar.	1925. April.	1925. May.	1925. June.
Wheat ...	38	42	79	62	59	62
Barley ...	17	48	45	38	36	38
Oats	41	32	38	34	36	38
Fat cattle ...	52	55	51	50	49	50
Fat sheep ...	83	93	97	100	100	93
Bacon pigs ...	62	29	67	68	60	54
Pork ,, ...	76	33	66	67	60	53
Dairy cows ...	50	59	48	47	48	47
Store cattle ...	31	47	43	39	40	43
Store sheep ...	114	121	104	100	99	115
Store pigs ...	130	32	47	64	55	55
Eggs... ...	40	43	49	51	48	52
Poultry ...	87	93	57	50	55	61
Milk	53	50	82	58	55	55
Butter ...	33	43	58	64	54	57
Cheese ...	44	83	57	61	70	78
Potatoes ...	—31*	174	138	115	124	76
Hay	42	3	—1*	—2*	3	3

* Decrease.

FIELD EXPERIMENTS AT ROTHAMSTED DURING 1923 AND 1924.

SIR JOHN RUSSELL, D.Sc., F.R.S.,
Rothamsted Experimental Station.

THE field experiments at Rothamsted deal in the main with problems of manuring, though increasing attention is now being paid to cultivations, liming and the growth of leguminous crops, especially lucerne. This preponderance of manuring in the programme is the outcome of the historical development of the Institution, and could be justified by the fact that the farmers of Great Britain make large amounts of farmyard manure and in addition buy great quantities of artificial fertilisers. It is difficult to obtain exact statements of the amounts of money expended, but on the assumption that one ton of straw makes four tons of manure, the value of the farmyard manure may be put roughly at about £14,000,000 per annum, while the amount spent on artificial manures is probably not much short of £8,000,000 per annum. Pending more accurate data, these figures indicate the importance of the problems, and they show how much the farming community may lose each year through even small wastes and losses of efficiency.

Nature of Action of Fertilisers.—It might be supposed that little remains to be learnt about fertilisers after all the experiments made in various parts of the country for the last 30 years. No one who has seriously studied the subject would admit this. The preference shown by farmers for compound fertilisers made up to a manufacturer's specification and not to their own shows that as a rule they mistrust their knowledge of fertilisers, while the keen interest always shown in the Rothamsted plots and in the Rothamsted lectures on the subject proves the great need for the work.

The farmer's purpose in using manures is to obtain larger and better crops, but experience shows that the manures have two distinct effects on the crop:—

(1) They increase the amount of plant growth.

(2) They alter the habit of growth or the character of the plant.

In consequence of this double action a crop increased by any fertiliser is not, so to speak, a photographic enlargement of an unmanured crop; there is always a distortion. The following experiment illustrates this point; swedes were grown without manure; with phosphates and potash but no nitrogen; and with phosphates, potash and nitrogen. Each crop was larger than the unmanured, but each was a distorted enlarge-

ment. The phosphates and potash enlarged the root more than the leaf; the nitrogen on the other hand enlarged the leaf more than the root. The figures are:—

WEIGHTS: TONS PER ACRE.

	No Manure	Phosphates and Potash No Nitrogen	Nitrogen with Phosphates and Potash
Root	24.0	25.7	27.7
Leaf	2.94	2.91	3.58

PROPORTION OF LEAF TO 1,000 OF ROOT.

	No Manure	Phosphates and Potash No Nitrogen	Nitrogen with Phosphates and Potash
Root	1,000	1,000	1,000
Leaf	121	112	129

Sometimes the distortion is not evident to the eye, though it is readily revealed by chemical analysis and shows itself in some "quality" character which may be important to the farmer or to the buyer. Potassic fertilisers increase the yield of potatoes but do not necessarily change their appearance. The potatoes grown in 1922 were carefully judged by one of the most experienced buyers in the London market; the samples were numbered, but no hint was given as to their manurial treatment. His marks showed very little connection with the fertiliser treatment; they were as follows:—

MANURIAL TREATMENT OF POTATOES.

Highest price:	Farmyard manure and muriate: farmyard manure and kainit: unmanured: French kainit.
Lower price:	Sulphate of potash: German kainit: potassium and magnesium sulphate.
Still lower:	Farmyard manure and sulphate of potash.
Lowest price:	Nitrogen and phosphate but no potash.

Analysis showed, however, consistent differences in chemical composition of the tubers manured in the various ways which would affect the feeding value and other properties included in "quality"; the figures are:—

PERCENTAGE OF STARCH IN DRY MATTER OF POTATOES.

No Potash	Potassic fertilisers		
	Sulphate	Muriate	Kainit
57.2	65.8	64.0	58.2

These distortions are also important in influencing the variations in fertiliser action in different seasons. It is common knowledge that the effectiveness of fertilisers varies with the weather conditions. This is not because of any erratic element in the

action of fertilisers; it is simply that the changes they produce in the growth of the plant may be important in one season, but not in another. The 1922 experiments with basic slag on swedes showed this well. The swedes without slag were late in starting, later even than those without manure; they were later in being ready for hoeing, and they ripened later. In some seasons this would have made an important difference to the crop. 1922 was, however, so good a season for swedes that the final advantage of using slag was only small and did not repay the cost of the slag. The yields were:—

No slag	... ...	28.1 tons per acre.
Slag.	Low grade, high soluble	29.0 ,, ,, ,,
	High grade, high soluble ...	30.4 ,, ,, ,,

A further illustration is afforded by the action of phosphates on barley. Addition of phosphates is followed by increased root development and increased tillering, and later on an earlier maturation as shown by the barley plants taken from the classical Hoos field at Rothamsted. The advantages of obtaining plants like those receiving phosphates as against those receiving none are many, quite apart from the obvious agricultural advantages. The gout fly does considerable damage each year to the barley crop; it lays its eggs near the top of the uppermost leaf, the larvæ crawl downwards and enter the young unformed ear if it is still ensheathed in its leaves, as in the case of the plants grown without phosphate; the larvæ then proceed to feed upon the ear and do much damage. If, however, the ear has shot out, as has happened where phosphate was given, the larvæ are unable to find it, and they continue crawling down till they reach the soil, where they perish. On Hoos field these effects are intensified by the long continued growth of one crop receiving always the same manurial treatment, but in many farming conditions they are produced to a greater or smaller degree; sometimes they are valuable and in other conditions they are not. The Rothamsted and the Woburn data illustrate these effects. The actual figures are:—

YIELD OF BARLEY GROWN IN ROTATION: MEASURED BUSHELS PER ACRE.

	Rothamsted			Woburn		
	1922	1923	1924	1922	1923	1924
Complete Manure ...	36.0	32.5	29.8	44.7	43.4	29.4
No Phosphate	36.8	34.4	30.6	39.9	38.8	38.8

In 1922 and 1923 the phosphate effect was valuable at Woburn, adding nearly 5 bushels per acre to the yield; in 1924 the phosphate was apparently harmful. At Rothamsted the effect was in no year important.

These results show that one must look always for two kinds of fertiliser action—increase in growth and change in habit. The latter may on some soils and in some seasons add to the certainty of the crop, enhance its value, give it a better chance of escaping insect or other pests or diseases; or have other effects of agricultural importance.

We can now turn to a consideration of the various crop results.

The Effect of Fertilisers on Cereals.—It is a commonplace that the yield of cereals can be increased by the use of nitrogenous fertilisers, but it is rather surprising that the increase should be so regular from season to season. For the past three years the gains from the use of 1 cwt. of sulphate of ammonia per acre have been :—

GAINS IN BUSHELS PER ACRE.

	1922 Rothamsted	1923 Rothamsted	1924 Rothamsted	1924 Outside Centres	Average of all soils and seasons to 1920
Wheat ...	3.25	—	—	4.3-6	4.5
Barley ...	5.5	4.5	8.25	3.5	6.5
Oats ..	—	8.3	—	—	7

These increases correspond to a recovery of about 35 or 40 per cent. of the nitrogen of the fertiliser.

A number of experiments have been tried to ascertain how far it is worth while increasing the dressing of nitrogenous manure. The earlier experiments at Rothamsted were made on wheat dressed with large amounts of ammonium salts in addition to substantial dressings of superphosphate and potassic and other salts; the increase in yield obtained by successively increasing the dressing of ammonium salts became less and less and finally

ceased to pay for the cost of the manure. This experiment was carried on from 1852-1864: it illustrates the incontrovertible law of diminishing returns, and always proves of absorbing interest to the agricultural economist. The figures were :—

Manures per acre	Dressed Grain—bushels		Straw—cwt.	
	Produce per acre	Increase for each additional 200 lb.N. in manure	Produce per acre	Increase for each additional 200 lb N. in manure
Minerals alone	18.3	—	16.6	—
,, + 200 lb. ammonium salts	28.6	10.3	27.1	10.5
,, + 400 lb. ,, ,,	37.1	8.5	38.1	11.0
,, + 600 lb. ,, ,,	39.0	1.9	42.7	4.6
,, + 800 lb. ,, ,,	39.5	0.5	46.6	3.9

All plots received a dressing of $3\frac{1}{2}$ cwt. superphosphate, 200 lb. sulphate of potash, 100 lb. sulphate of soda and 100 lb. sulphate of magnesia, in addition to the ammonium salts. Clearly there is no advantage in giving dressings exceeding 400 lb. of ammonium salts per acre. But it is equally clear that the figures afford no guidance in present day conditions. It is of no practical importance to discuss whether one could justifiably increase manurial applications to wheat from 400 lb. ammonium salts and 800 lb. of other fertilising salts—nearly 11 cwt. of fertiliser in all—to 800 lb. ammonium salts and 800 lb. of other fertilisers, since no one would use anything like these quantities in practice. The experiment is of great value in other directions, but it affords no guidance to the farmer uncertain whether to use $\frac{1}{2}$ cwt., 1 cwt. or 2 cwt. sulphate of ammonia per acre as a top dressing.

In the more recent experiments, the effect of 1 cwt. sulphate of ammonia is compared with that of 2 cwt. per acre. In four out of six years, the increment of gain has been greater for the second cwt. than for the first; in other years the wheat crops were poor and the results uncertain, while the barley of 1922 did not exceed 33.3 bushels per acre. The figures in bushels per acre are :—

EFFECT OF SULPHATE OF AMMONIA IN INCREASING THE YIELD OF CEREALS.

* Crop.	No Nitrogen	1 cwt. sulphate of ammonia	2 cwt. sulphate of ammonia	Increase in yield for 1st cwt.	Increase in yield for 2nd cwt.
1920 Wheat ..	28.9	28.7	35.9	Nil	7.2
1921 Wheat ...	17.5	18.1	17.9	Nil	Nil
1922 Wheat ...	13.4	17.1	19.8	3.7	2.7
Barley ...	25.2	32.3	33.3	7.1	1.0
1923 Oats ...	29.2	37.3	46.5	8.1	9.2
Straw (cwt.)	19	26	36	7	10
1924 Barley ...	23.9	32.5	42.7	8.6	10.2

The straw of the 1920 wheat and of the 1923 oats, like that of the grain, showed greater increases for the second dose of sulphate of ammonia than for the first, but the barley straw did not: nor did the total produce. The oat results for 1923 are given in the table above: the barley figures were:—

* Crop.	Straw, cwt. per acre	Gain for 1 cwt. sulphate of ammonia	Total produce lb. per acre	Gain for 1 cwt. sulphate of ammonia
No Manure	14.0	—	2,987	—
Basal manure only ...	14.1	—	3,010	—
Basal + 1 cwt. sulphate of ammonia	19.7	5.6	4,188	1,178
Basal + 2 cwt. sulphate of ammonia	24.7	5.0	5,285	1,097

Physiological investigations are being undertaken to find out the principles underlying these results. So far as the evidence goes it appears that 2 cwt. of sulphate of ammonia (and there seems no reason why nitrate of soda should behave differently, though the experiment has not been made) gives in good seasons more than double the increased yield of corn obtained from 1 cwt., but in bad seasons the full increase is not obtained. It is not suggested that 4 cwt. of the fertiliser would give more than twice the increase given by 2 cwt., for the law of diminishing returns inevitably begins to operate somewhere; but it seems clear that a series of increasing returns precedes the setting in of the diminishing return.

This experiment is being continued, and it might advantageously be repeated at other centres. The wide-spread use of stiff-strawed varieties of cereals renders possible more

* The varieties were:—Wheat, Red Standard; Oats, Grey Winter; Barley, Plumage Archer.

manuring than could formerly be justified, and since the manuring is in any case only a minor item in the cost of growing cereals, it can more safely be increased than could a more expensive item.

Investigations have been begun to study the effect of altering the time of application of the fertiliser. The late application of the larger dressing of sulphate of ammonia has been more effective than the early application in increasing the yield of grain, but not in increasing the yield of straw. Thus in 1924 the yields of oats were :—

YIELD OF OATS, BUSHELS PER ACRE.

	No Nitrogen	1 cwt. sulphate of ammonia	2 cwt. sulphate of ammonia	Gain for 1 cwt. sulphate of ammonia		Total gain for 2 cwt. sulphate of ammonia
				1st dose	2nd dose	
——	29.2	—	—	—	—	—
Early application ...	—	37.3	46.5	8.1	9.2	17.3
Mid-season	—	37.7	45.4	8.5	7.7	16.2
Late application ...	—	34.6	53.7	5.4	19.1	24.5

The dates of applying the dressings were :—

1. Applied early (March 28th).
2. Applied mid-season (April 22nd).
3. Applied late (May 22nd).

The increment in yield of straw, like that of grain, is greater for the second dose of sulphate of ammonia than the first, but it is not greater for the late season applications than for the early dressings :—

YIELD OF OAT STRAW, HUNDREDWEIGHTS PER ACRE.

	No Nitrogen	1 cwt. sulphate of ammonia	2 cwt. sulphate of ammonia	Gain for 1 cwt. sulphate of ammonia.		Total gain for 2 cwt. sulphate of ammonia
				1st dose	2nd dose	
——	19	—	—	—	—	—
Early application ...	—	26	36	7	10	17
Mid-season	—	27	32	8	5	13
Late application ...	—	23	34	4	11	15

Indications of a similar action were obtained with the wheat in 1921, but no great importance attaches to the results owing to the lowness of the yields. The experiment is now being followed up.

Use of Ammonium Chloride.—The experiments described above were made with sulphate of ammonia, a fertiliser produced in large quantities in this country as a by-product from coal at gasworks, coking ovens and other works. Since the war there has been available another ammonium salt, the chloride or muriate, also made in this country, but direct from the nitrogen of the air. It is understood that the muriate could be supplied more cheaply than the sulphate. For the past four years field experiments have been made at Rothamsted and at various outside centres to study the behaviour of the two compounds, the comparison being on the basis of equal amounts of nitrogen supplied per acre. The usual result at Rothamsted, Woburn and elsewhere in the corn-growing centres has been for the muriate to give the better results for cereals; when the yields from 1 cwt. sulphate of ammonia are put at 100, the yields from the equivalent quantity of muriate have been for corn crops at Rothamsted:—1921, 106; 1922, 103; 1923, 109; 1924, 104.

The effect of the muriate is somewhat more marked on the grain than on the straw, suggesting that the chloride brings about a greater translocation of material from the leaf and stem to the grain than the sulphate is able to effect. A double dressing of the muriate further increased the yield, and indeed gave the highest values obtained at Rothamsted. The results for barley in 1924 at Rothamsted were:—

GRAIN, BUSHELS PER ACRE.

	Sulphate of Ammonia		Chloride of Ammonia		Ratio of yield Chloride: Sulphate
	Yield	Increment due to dose of N.	Yield	Increment due to dose of N.	
No Nitrogen.	23.9	—	23.9	—	—
Single dose Nitrogen	32.5	8.6	34.8	10.9	107 : 100
Double dose Nitrogen	42.7	10.2	45.3	10.5	106 : 100

Support is given to this view by the chemical examination of the grain; the percentage of nitrogen is diminished by the chloride as compared with the sulphate, indicating a greater piling up of non-nitrogenous or of carbohydrate material.

The figures are:—

NITROGEN PER CENT. IN BARLEY GRAIN

	1922	1923	1924
Sulphate of ammonia	1.647	1.544	1.517
Ammonium chloride	1.602	1.485	1.495

The Quality of the Crop.—So far only the effect on yield has been considered; there is, however, the very important question whether the quality of the crop has suffered or the straw has become weakened by the nitrogenous top dressings. No evidence of any harmful effect was obtained. Present day varieties of corn crops stand up well, and there has been no trouble about lodging. The question of quality in barley is being studied at some length, quality being to the farmer more important for this than any other corn crop under present conditions. The experiments were made at Rothamsted and on certain good barley farms in various parts of the country, the work being done in connection with the research scheme of the Institute of Brewing. The variety grown is Plumage Archer, and seed from the same field was used at all the centres.

The results show a considerable degree of concordance among themselves, but they differ in several important respects from the current teachings of agricultural science. It is usually recommended that the manuring for barley should be mainly phosphatic, nitrogen being given only in special circumstances and potash but rarely. Out of 30 different tests, this recommendation would have involved loss of money in no less than 26; the average reduction in yield caused by the omission of each fertiliser during the three years, 1922, 1923 and 1924, being in bushels per acre :—

Decrease due to omission of :—	After a straw crop	After roots fed off	After potatoes or beets (well manured)	Mean of all experiments
1 cwt. sulphate of ammonia	5.8	3.9	6.7	5.4
3 cwt. superphosphate ...	0.9	(0.5)	1.2	0.5
1½ cwt. sulphate of potash	(1.1)	1.3	1.1	0 3

(The figures in brackets are increases and not decreases)

The reasons for this unexpected result are probably two :—

1. The modern varieties of high quality barley, such as Plumage Archer, are stiffer in the straw than the older ones, and therefore can carry larger crops of grain without danger of being lodged. Apparently, therefore, they can safely receive more nitrogenous manuring.

2. Good farmers now realise the importance of giving ample dressings of superphosphate to their root crops, and sufficient

of this fertiliser generally remains in the soil to satisfy the needs of the barley. Potash and phosphates intended for the seeds mixture can, of course, be applied to the barley in which they are sown. The barley may derive benefit, but the profit, if any, must come from the seeds.

One of the distinguishing features of the scheme is that all the experimental barleys are examined by expert maltsters appointed by the Research Committee of the Institute of Brewing, and are afterwards malted separately and the malts fully analysed.

It is shown that the use of a nitrogenous manure, even after roots folded off, has not adversely affected the valuation of the barley or the value of the malt, but that the omission of potash from the manure lowered some of the desirable qualities of the malt in 1922, though not apparently in 1923. At each centre the heaviest crops obtainable by manuring have been valued as high, or nearly as high, per quarter, as any other samples of the same set, and it is clear that manurial schemes can be devised which will enhance the present yield without detriment to valuation. So far as the investigation has gone, it suggests that farmers using a good modern variety of barley can aim at the biggest crop that will stand, and they can use the appropriate fertiliser to secure this without fear of loss of valuation. Thus, for the season 1923 the figures for valuation per quarter of 448 lb. made in January, 1924, were :—

	Rothamsted	East Lothian	Eyton	Chiselborough	Walcott	Warminster	Lincs Wolds
1 cwt. sulphate of ammonia	57/-	49/6	49/-	47/-	41/6	52/-	42/-
No nitrogen	56/-	49/-	50/-	46/-	41/-	52/-	41/6

It has already been stated that the nitrogen content of the grain is lowered when the muriate of ammonia is used as a fertiliser instead of the sulphate. Although the valuers did not know this—nor indeed did they know anything of the manurial treatment of the samples before them—they had no hesitation in placing the higher valuation per quarter of 448 lb. on the barley that had received the muriate. When yield and valuation are taken together and reckoned in terms of money value per acre, and when tail corn is allowed for, there comes out an important difference in favour of the muriate :—

	Valuation of Barley per quarter of 448 lb.		Money Value per acre		Difference per acre in favour of chloride as against sulphate
	Ammonium Sulphate	Ammonium Chloride	Ammonium Sulphate	Ammonium Chloride	
1922	31/-	36/-	136/-	156/-	20/-
1923	57/-	58/-	239/-	265/-	26/-
1924	63/-	64/-	238/-	249/-	11/-

In the course of the work it has become clear that the method of valuation commonly adopted does not always work out quite fairly either to the buyer or to the farmer. On the loams the estimate has usually come out tolerably correctly; the value of the malt has paid the cost of the barley, the transport expenses, and profits of malting and other charges. But on the lighter soils the barley has not generally been as good as it looked, so that the value of the resulting malt did not pay all the charges. On the chalk and limestone soils the barley turned out better than it looked; the farmer received less than he deserved and the malt gave an additional profit to the maltster.

These results are quite intelligible. The buyer judges from external appearances of the barley which are on the whole correlated with the value of the resulting malt. But the correlations between the external characteristics and chemical composition are liable to be affected by changes in environment, and it need occasion no surprise that a correlation holding good on loams may be modified in one direction on a sandy soil, and in another on a chalk soil.

The malting and brewing part of the investigation lies outside the scope of Rothamsted, and is carried out entirely by the Institute of Brewing, but the Station, at the cordial invitation of the Institute, is keeping in close touch with the work.

A curious fertiliser effect which is being followed up is the occasional injury to yield which seems to follow the application of potash or of phosphates. The effect is not always obtained, even at the same centre: Woburn, in 1924, afforded an example of apparent injury of phosphate to barley; Wellingore shows an apparent injury of potassic fertilisers in 1922 and 1924, two years out of three in which the experiment was tried; and Rothamsted showed apparent injury in 1924.

BARLEY: BUSHELS PER ACRE
WELLINGORE.

	1922		1923		1924		Rothamsted 1924	
	Yield	Difference from complete fertiliser	Yield	Difference from complete fertiliser	Yield	Difference from complete fertiliser	Yield	Difference from complete fertiliser
Complete fertiliser	39.0		45.8		50.7		29.8	
No potash ...	43.5	+4.5	43.8	−2.0	58.2	+7.5	34.4	+4.6
No phosphate	40.5	+1.5	46.4	Nil	49.9	Nil	30.7	Nil
No nitrogen	37.3	−1.7	39.2	−6.6	45.2	−5.5	22.0	−7.8
No manure	36.1	−2.9	40.8	−5.0	43.8	−6.9	25.8	−4.0

Effect of Fertilisers applied to Cereals on Clover Crops sown in them.—Fertilisers applied to cereals may affect clover sown in them, and any injury done must be set off against the gains.

The experiments show that potassic fertilisers applied to barley at Rothamsted exert a distinctly beneficial effect on the clover in the following year, giving an additional 12 cwt. of clover hay in 1923 (barley of 1922), and 6 cwt. in 1924 (barley of 1923). Sulphate of ammonia applied to the barley also appeared to benefit the clover; we do not understand this result, and it is being further studied. The Rothamsted soil contains sufficient calcium carbonate to prevent any possibility of acidity: otherwise the clover is liable to be injured. Phosphates on our soil produce no residual effect on the clover. The results have been:—

Year in which clover was sown	No Nitrogen	Yield of clover in following year, after fertiliser applied to barley. Cwt. per acre.)				
		Sulphate of Ammonia	Muriate of Ammonia	No Potash	Sulphate of Potash	Muriate of Potash
1921		All clover failed				
1922	31.0	35.1	37.1	23.7	36.8	39.1
1923	61.5	72.3	63.6	23.7	36.1	39.1
1924		Crop still growing				

The Manuring of Potatoes.—Two extensive series of experiments have been carried out with potatoes: the effect of nitrogenous manure (chiefly sulphate of ammonia) and the effect of various potassic fertilisers.

On an average, the addition of 1 cwt. sulphate of ammonia per acre has increased the yield of potatoes by 20 cwt. per acre. Second and third doses of sulphate of ammonia give further increases, but not usually as much as did the first: for with this crop, unlike the cereals, the increment of the return generally falls off from the beginning, though the higher dressing still remains profitable because of the higher value of the potato crop.

The yields, in tons per acre, have been as follows:—

	No Nitrogen	$1\frac{1}{2}$ cwt Ammonium Sulphate	3 cwt Ammonium Sulphate	$4\frac{1}{2}$ cwt Ammonium Sulphate	Increment in yield for 1st dose	2nd dose	3rd dose
1922	6.07	7.99	9.73	10.08	1.92	1.74	0.35 (1)
	5.50	7.37	8.97	8.98	1.87	1.60	Nil (2)
1923	12.0	13.7	15.1	14.8	1.7	1.4	Nil
1924	8.0	9.5	9.4	—	1.5	Nil	—

(1) with 15 tons farmyard manure. (2) No farmyard manure.

The effect of the nitrogenous dressing depends on the time of application. In all our experiments it has proved better to apply the sulphate of ammonia with the seed rather than to give it later as a top dressing when the plants are showing through the ground. The yields of potatoes in tons per acre in 1923 and 1924 have been:—

		All ammonium sulphate given with seed.	$\frac{1}{2}$ ammonium sulphate given with seed, $\frac{1}{2}$ as top dressing.
1923	Basal manure alone ...	12.0	—
	,, ,, + 3 cwt. Sulphate of Ammonia	15.7	15.25
1924	Basal manure alone ...	8.03	—
	,, ,, + 3 cwt. Sulphate of Ammonia	9.41	9.16

Ammonium chloride, or muriate, has been generally less effective for potatoes than ammonium sulphate, but the difference depends very much on the rainfall. In dry conditions, chloride is distinctly inferior: in wet conditions the difference becomes less, and finally disappears. Thus, in 1923, when the rainfall during March, April and May was 5.64 in., the chloride had only 92 per cent. of the efficiency of the sulphate, while in 1924, when the rainfall was much higher (8.95 in.), the two fertilisers were equally efficient:—

YIELD OF POTATOES: TONS PER ACRE.

	1923	1924
Using ammonium sulphate	15.12	9.41
chloride	13.94	9.38
Difference in favour of sulphate	1.18	Nil
Rainfall: March, April, May	5.64 in.	8.95 in.

The other series of experiments has been made to study the effect of the various potassic fertilisers. Although the Rothamsted soil is heavy, and naturally well supplied with potash, the potato crop nevertheless responds to potassic fertilisers, even when dung is supplied in addition. The gains in tons per acre from sulphate of potash have been :—

	1921	1922	1923	1924
Dung and 1½ cwt. sulphate of potash ...	0.31	1.52	0.79	Nil
No dung; 2 cwt. sulphate of potash ...	2.41	5.83	2.53	1.08

It is interesting to contrast these with the gains from 1 cwt. sulphate of ammonia, in tons per acre :—

	1921	1922	1923	1924
Dung	—	1.28	1.02	—
No dung	0.15	1.24	1.74	0.97

Certain qualitative effects of the potassic fertiliser are always shown. These were particularly striking in 1921, the worst year we have had, when the potatoes without potash died early in the season, while those with potash were still growing. In 1923, the record year for good yields, growth was not as rapid on the "no potash" plot, even in the presence of dung, as it was where potash was supplied, and although later on there seemed to be the same amount of growth, the leaves of the "no potash" plot were dull and dark green. Towards the end of August the plants without potash developed leaf-curl, and by the end of September a large proportion were dead. These appearances were intensified on the plots receiving no dung.

As between the various potassic fertilisers, the muriate and the sulphate of potash have been nearly, but not quite, alike in their effect, the muriate giving sometimes a slightly better and sometimes a slightly lower yield than the sulphate. The determining factor is partly rainfall, the sulphate tending to give the higher yield in drier conditions and the muriate in wetter, but there is something besides this, for in 1921 the sulphate came out the better in spite of the wetness of the season.

Sodium chloride given in addition to the muriate of potash, is injurious; neither kainit nor sylvinite yielded the full benefit expected from the potash because of the harmful effects of the salt. This is to some extent mitigated by additions of dung, but the crop always falls below that obtainable from the muriate or the sulphate of potash. The average of the results at Rothamsted and at outside centres inspected by our Staff is :—

Yield of Potatoes when that from Sulphate of Potash = 100

	1922		1923		1924
	Without dung	With dung	Without dung	With dung	With dung
Muriate of potash ...	102	99	104	105	95
Sylvinite	85	93	91	100	87

The effect of these fertilisers on the quality is being studied in detail. Of the complete manured plots, those receiving sulphate of potash produce tubers with the highest percentage of dry matter :—

Potassic Fertiliser Used	Percentage dry matter of potato tubers grown at				
	Rothamsted		Rease-heath	Seale-Hayne	Usk
	1922	1923	1922	1922	1923
Sulphate ...	24.26	21.73	21.68	24.4	23.6
Chloride ...	22.02	20.85	21.63	22.3	22.5
Low grade salts	19.68	17.87	17.28	22.7	21.0
No potash ...	23.07	20.65	17.62	25.7	22.1

The tubers grown with low grade potash salts (kainit, sylvinite) are the lowest in dry matter content, coming out even below those grown without potash.

The percentage of starch in the dry matter is an important quality factor, and in all tubers so far analysed, the value comes out higher for the sulphate of potash than for any of the other salts.

Percentage of Starch.

	Yield in tons per acre	Dry matter per cent. in tubers	Starch per cent. in dry matter	Starch
Sulphate ...	8.30	24.26	68.84	1.325
Chloride ..	8.32	22.02	64.00	1.175
Low grade salts	8.06	19.68	58.20	0.925
No potash ...	2.47	23.07	57.16	0.325
Control ...	2.98	23.36	58.20	0.405

These differences in density and composition are not clearly indicated by any external character, and, as already stated, an expert buyer in the London market failed to discriminate clearly between the potatoes grown with potassium sulphate and those grown with the muriate or even kainit. A cooking test made by courtesy of Messrs. Lyons by one of their expert chefs gave a more definite result, the order of merit being :—(1) Sulphate of

potash; (2) Muriate of potash; (3) Muriate of potash and salt—No potash.

Another cooking test made by a good amateur agreed in placing first on the list the potatoes which had received sulphate: the order was:—(1) Sulphate of potash; (2) Muriate of potash and salt; (3) No potash; (4) Muriate of potash.

Mr. Eden has devised a simple test based on the specific gravity differences which promises to be useful in rapidly assessing quality. The potatoes are placed in a salt solution of the proper strength: the potatoes of high dry matter and starch content sink while those of lower quality float.

One would not expect to find any close relationship between the behaviour of cereals and of potatoes towards fertilisers. But it repeatedly happens that the potatoes behave in exactly the opposite way to the cereals. This is most easily shown as follows:—

	Corn.	*Potatoes.*
Effect of second and subsequent doses of sulphate of ammonia.	Often increased increment of yield.	Always decreased increment of yield.
Effect of time of application of sulphate of ammonia.	Late application sometimes best.	Early application always best.
Effect of muriate of ammonia compared with sulphate of ammonia.	Muriate gives better yield, especially in dry conditions.	Muriate not so good yield, especially in dry conditions.
	Muriate gives better quality.	Muriate not so good for quality.

The contrast shows very clearly when one brings together the results for muriate and sulphate of ammonia:—

VALUE FOR EFFECTIVENESS OF MURIATE OF AMMONIA WHEN SULPHATE = 100.

Year	1921	1922	1923	1924
Yield of Corn	106	103	109	104
Nitrogen in Grain of Barley ...	—	97.3	96.2	98.4
Yield of Potatoes	(112)*	95	92	100
Rainfall (Mar., Apr., May) ...	4.08	7.38	5.64	8.95

* Crop almost failed: 2 tons per acre only.

These curious effects present to laboratory investigators a number of interesting problems which are being further studied.

YIELDS OF POTATOES WITH VARIOUS POTASSIC FERTILISERS : TONS PER ACRE.

	1921		1222		1923			
					Rothamsted		Outside centres	
	Dung	No Dung	Dung	No Dung	Dung	No Dung	Dung	No Dung
plete artificials ...	3.94	3.76	9.55	8.30	12.45	12.25	10.04	9.40
otash	3.63	1.35	8.03	2.47	11.66	9.72	8.83	6.85
rtificials ...	3.33	1.54	—	2.98	10.48	7.95	7.22	5.90
inite ...	—	—	—	7.73	10.48	10.61	9.83	8.60
from complete ificials	0.61	2.22	—	5.32	1.97	4.30	2.82	3.50
from sulphate of tash	0.31	2.41	1.52	5.83	0.79	2.53	1.21	2.55

* * * * * *

THE INFLUENCE OF ROOTS AND OTHER FEEDING STUFFS ON MILK PRODUCTION.

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THE practice of rationing dairy cows according to their milk yield has, during recent years, been a factor of very considerable importance in controlling the cost of producing milk. Sufficient records now exist from which conclusions can be drawn which should be of interest and possibly guidance to a number of farmers engaged in the production of milk.

During the past five years returns have been systematically collected by the Milk Recorders of the East Sussex Milk Recording Society and these now form a record containing a considerable amount of useful information.

It is common knowledge that great differences of opinion exist not only amongst farmers, but also amongst agricultural investigators concerning the effects of different feeding stuffs. Many of these opinions so firmly held by farmers are diametrically opposed to each other and in a number of cases are undoubtedly erroneous, being based on either individual experience or on too small a number of examples to have any general value. A farmer frequently attributes an increase or a decrease in his milk yield to some factor quite different from the real cause, and it is because of these differences of opinion amongst farmers and others that the conclusions drawn from the records collected should have economic value.

Method of Examination of Records.—In all 1,665 different records of herds have been examined and these relate to 35,218

rations fed to cows under varying circumstances. Each group of 100 herds contains on the average approximately 2,000 cows. The herds have been recorded weekly and the results checked by the recorders of the East Sussex Milk Recording Society. It may be contended that other factors than those connected with the feeding would influence the yield. This is admittedly so, but these differences would tend to disappear when such a large number is considered. For example, it might be argued that low yields are in many cases due to an advanced lactation period. In certain individual cases of cows, not of herds, this may be so, but generally the herds are essentially winter milk-producing herds. Practically all the cows in the groups referred to would calve in or near October, whilst the records commence in November and are continued until about the middle of March, so that the question of low yields being due to advanced lactation periods does not arise.

Again, it might be contended that larger quantities of roots have been fed to the cows giving the greatest quantity of milk and not that the higher milk yield is due to the larger quantity of roots. This, generally, is not so in the herds concerned as it is the usual practice to feed the herds uniformly with roots and the quantity of roots is not varied according to the individual yield of the cow but depends on the amount of roots available during the winter months. Thus, after a drought, when roots are scarce, the quantity fed is naturally considerably smaller than in normal years.

A further contention might be that the low yields are due to insufficient feeding, but generally it has been found that, if anything, the tendency has been that the low-yielding herd is usually overfed, and the high-yielding herd underfed.

The Effect of Feeding Roots on the Milk Yield.—In East Sussex the general opinion of dairy farmers is that roots play a very marked part in increasing the yield of milk when other factors are constant. On the other hand, there are a number of farmers who are strongly opposed to growing roots for milk production and are convinced that they can be replaced more economically by concentrated feeding stuffs. An examination of the data collected in these records appears to indicate that as far as East Sussex is concerned the quantity of milk rises in direct proportion to the amount of roots fed. As will be noted from the appended figures, the average yields of these herds vary from 1.28 gallons per cow to 3.39 gallons per cow, whilst it will be noted from Table 1 *that there is a proportionate*

increase throughout in the amount of roots fed varying from 15.46 lb. at one extreme to 40.36 lb. at the other. Included in these figures are those herds to which roots were not fed. In individual cases the amount of roots fed far exceeds the average amount, but these wide divergencies disappear when averages of records of 100 herds are considered.

Table 2 shows the results, *excluding* the herds which received no roots. The yield of the different groups of 100 herds here varies from 1.37 gal. to 3.26 gal., and again the increase in yield of milk appears to be in direct proportion to the increase in roots.

Table 1.

ROOTS.

	Average Yield of Milk per Cow. Gal.	Average Amount of Roots fed per Cow. lb.
1st 100 Herds (Lowest)	1.28	15.46
2nd ,, ,,	1.53	24.31
3rd ,, ,,	1.65	24.83
4th ,, ,,	1.76	22.81
5th ,, ,,	1.84	29.77
6th ,, ,,	1.94	27.61
7th ,, ,,	2.00	30.72
8th ,, ,,	2.07	30.90
9th ,, ,,	2.13	30.45
10th ,, ,,	2.20	30.34
11th ,, ,,	2.26	38.75
12th ,, ,,	2.34	33.88
13th ,, ,,	2.43	36.63
14th ,, ,,	2.53	34.27
15th ,, ,,	2.67	37.16
16th ,, ,,	2.91	38.06
17th (65) ,, (Highest)	3.39	40.36

Table 2.

ROOTS

(Excluding all Herds receiving no Roots).

	Average Yield of Milk per Cow. Gal.	Average Amount of Roots fed per Cow. lb.
1st 100 Herds (Lowest)	1.37	27.92
2nd ,, ,,	1.61	31.23
3rd ,, ,,	1.74	29.28
4th ,, ,,	1.86	36.66
5th ,, ,,	1.97	33.51
6th ,, ,,	2.03	33.00
7th ,, ,,	2.11	36.03
8th ,, ,,	2.18	38.92
9th ,, ,,	2.26	40.54
10th ,, ,,	2 35	38.41
11th ,, ,,	2.46	41.62
12th ,, ,,	2.57	41.57
13th ,, ,,	2.78	42.22
14th (87) ,, (Highest)	3.26	47.52

Succulent Food including Roots.—Succulent foods, such as marrow-stem kale, thousand-headed kale, rape and cabbage, play a part of considerable importance in connection with milk production in East Sussex, and are to some extent interchangeable with roots. Table 3 shows again the direct relation between the increase of milk produced and the increase of succulent food fed.

Apart from the importance of increased milk yield arising from the use of roots and other succulent food, there are other factors of considerable importance. It is well known that herds of dairy cows fed almost exclusively on wet grains yield large quantities of milk, but that under this system of feeding they do not long stand the strain of heavy milk production, whilst further, it is possible that sterility, which so frequently occurs amongst such herds, may be due to a deficiency of some mineral or other substance from the diet. To milk producers, therefore, it is of no small importance to realise that with the feeding of roots and other succulent crops, not only apparently is the output of milk increased, but still further that such rations help to eliminate risks of mineral or other deficiencies in the food.

If this conclusion concerning roots and other succulent food is correct, it has a wide bearing on agriculture generally, as it is the root crop which secures during the rotation that extra amount of cleaning and tillage which has such a beneficial effect on subsequent corn crops.

Table 3.

ROOTS

(Including Cabbage, Kale and Rape).

	Average Yield of Milk per Cow. Gal.	Average Amount of Roots fed per Cow. lb.
1st 100 Herds (Lowest)	1.28	18.93
2nd ,, ,,	1.53	28.45
3rd ,, ,,	1.65	27.41
4th ,, ,,	1.76	25.97
5th ,, ,,	1.84	33.89
6th ,, ,,	1.94	31.92
7th ,, ,,	2.00	34.72
8th ,, ,,	2.07	35.04
9th ,, ,,	2.13	32.94
10th ,, ,,	2.20	34.39
11th ,, ,,	2.26	41.60
12th ,, ,,	2.34	37.61
13th ,, ,,	2.43	38.85
14th ,, ,,	2.53	39.78
15th ,, ,,	2.67	42.50
16th ,, ,,	2.91	43.97
17th (65) ,, (Highest)	3.39	47.13

The Effect of Hay, Straw and Chaff.—During the past winter farmers have naturally wished to feed as high a proportion of hay as possible to their dairy herds owing to its low market price compared with the price of concentrated food. There is, apparently, a limit to economy in this direction, and it will be seen from the figures collected that hay and similar bulky dry foods are not instrumental in increasing milk yield after a certain limit has been reached, and this limit does not appear to exceed a total of 18 lb. per head per day. As will be seen from Table 4, *there is no relation between the amount of hay fed and the yield of milk produced*, but there is an indication that the hay may even have a depressing effect on milk yield. This is probably due to the fact that too much of the energy value of the diet may be utilised in rendering digestible a ration consisting of a high proportion of bulky dry food, and as has been suggested by certain investigators, the control of the bulk of dry food fed to dairy cattle is a factor of importance if heavy milk yields are desired. It had been observed from the records collected for some years that a high average yield never appeared to be obtained when the amount of hay or straw was higher than about 17 lb. It is probable that on a number of farms not only do the heavier quantities of hay and straw fed produce no beneficial result, but have actually a detrimental effect on the yield of milk.

Table 4.
HAY, STRAW AND CHAFF.

	Average Yield of Milk per Cow. Gal.	Average Amount of Hay, Straw and Chaff fed per Cow. lb.
1st 100 Herds (Lowest)	1.28	17.00
2nd ,, ,,	1.53	17.29
3rd ,, ,,	1.65	16.87
4th ,, ,,	1.76	16.64
5th ,, ,,	1.84	17.09
6th ,, ,,	1.94	17.91
7th ,, ,,	2.00	17.93
8th ,, ,,	2.07	16.44
9th ,, ,,	2.13	18.93
10th ,, ,,	2.20	18.21
11th ,, ,,	2.26	16.76
12th ,, ,,	2.34	18.06
13th ,, ,,	2.43	17.57
14th ,, ,,	2.53	16.52
15th ,, ,,	2.67	17.11
16th ,, ,,	2.91	17.49
17th (65) ,, (Highest)	3.39	16.73

Concentrated Food.—As might have been expected, the records indicate that common opinion is correct concerning concentrated foods and that milk yields vary in accordance with the

amount of concentrated food fed, but, as will be seen from Table 5, although there is a direct relation between the two, and although the milk yield increases as does the amount of concentrated food, the increase in yield is a greater relative increase than is the increase in amount of the food fed: thus the yield varies from 1.28 to 3.39 gal. or as 1 to 2.6, whereas the concentrated food fed is in the proportion of 1 to 2.0. It seems, therefore, that not only does the milk yield vary with the amount of concentrated food fed, but that the high-yielding herds make better use of the concentrated food than do the low-yielding herds.

Table 5.

CONCENTRATED FOODS.

	Average Yield of Milk per Cow. Gal.	Average amount of Concentrated Foods fed per Cow. lb.
1st 100 Herds (Lowest)	1.28	3.55
2nd ,, ,,	1.53	3.54
3rd ,, ,,	1.65	3.96
4th ,, ,,	1.76	3.88
5th ,, ,,	1.84	4.51
6th ,, ,,	1.94	3.80
7th ,, ,,	2.00	4.09
8th ,, ,,	2.07	4.23
9th ,, ,,	2.13	4.31
10th ,, ,,	2.20	4.47
11th ,, ,,	2.26	4.55
12th ,, ,,	2.34	5.12
13th ,, ,,	2.43	4.75
14th ,, ,,	2.53	5.38
15th ,, ,,	2.67	6.11
16th ,, ,,	2.91	6.27
17th (65) ,, (Highest)	3.39	7.15

Table 6.

AVERAGE NUMBER OF DIFFERENT FOODS FED PER COW.

	Average Yield of Milk per Cow. Gal.	Average No. of Diff. Foods fed per Cow.
1st 100 Herds (Lowest)	1.28	5.24
2nd ,, ,,	1.53	5.81
3rd ,, ,,	1.65	5.85
4th ,, ,,	1.76	6.42
5th ,, ,,	1.84	6.05
6th ,, ,,	1.94	6.53
7th ,, ,,	2.00	6.47
8th ,, ,,	2.07	6.38
9th ,, ,,	2.13	6.87
10th ,, ,,	2.20	6.92
11th ,, ,,	2.26	6.82
12th ,, ,,	2.34	6.78
13th ,, ,,	2.43	7.09
14th ,, ,,	2.53	7.19
15th ,, ,,	2.67	7.16
16th ,, ,,	2.91	7.33
17th (65) ,, (Highest)	3.39	7.24

The Relation between the Number of Feeding Stuffs Used and Milk Yield.—It has, perhaps, not been generally realised that there appears to be a direct relation between milk yield and the *number* of feeding stuffs used, apart from the food contents of the rations. Previously a number of investigators have seemed to conclude that provided a ration contained sufficient starch equivalents and protein, the varieties of feeding stuffs used did not play a part of considerable importance; thus, to take an example; a farmer might feed a ration in accordance with the accepted standards consisting of hay, cotton seed meal and maize meal, whereas another farmer might have adopted similar standards as far as the amounts of starch equivalents and protein were concerned, and have a ration consisting of hay, oat straw, kale, roots, soya bean meal, dried grains and maize gluten. Other things being equal, it seems certain that the farmer feeding the varied ration will obtain better results than the former. This had seemed apparent from the records for some considerable time, but it was scarcely anticipated that the conclusion would have been so well substantiated as it appears to be from Table 6, column 3. The figures given are the averages of the records of 100 herds in each case and cannot, therefore, be given in whole numbers, but it is seen that as the milk yield increases, so does the *number* of different feeding stuffs used.

The Conclusions which the writer has drawn from examination of the records, and his observations of the records and herds during the past five years are as follows, other things being equal :—

(1) That balanced rations containing the required standards of starch equivalents and digestible protein are enhanced in value if the constituents of the ration consist of several different kinds of feeding stuffs.

(2) That the milk yield in East Sussex increases in direct proportion to the amounts of roots and other succulent foods fed up to about 45 lb. per head per day.

(3) That hay and straw and similar bulky dry food above a limit of 17 lb. have no influence in increasing milk yield, but may actually have a depressing effect on the output.

(4) That the milk yield is in proportion to the amount of concentrated food used up to at least 7¼ lb. per head per day, but that there is a greater rate of increase in the yield of milk than in the increase of concentrated food fed.

Although it cannot be claimed that these conclusions are proved by records examined (owing to the presence of different

variables, the data should be submitted to a statistical analysis), the records at least indicate the practice of those who succeed in securing the best results.

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EARLY AGRICULTURAL LITERATURE.

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FOR the beginnings of English agricultural literature we must go back to the middle of the thirteenth century. About 1260 there appeared a little handful of agricultural treatises of which the best known is that of Walter of Henley.

The Middle Ages.—The agricultural industry of that time was of a self-sufficing character and in its organisation differed materially from present conditions. The arable land of the mediæval village was arranged in two or three blocks, each block being divided into a considerable number of strips varying from an acre to half an acre in extent. All the farmers of the village, from the Lord of the Manor down to the Cottar with his small holding of seven or eight acres, had their land distributed in scattered strips in these "open-fields." The large landowner possessed shares in the land of a number of village communities, and upon these shares he grew the corn and fed the cattle that were necessary to maintain his household during the year. The villagers also maintained themselves out of the strips they cultivated, paying an insignificant money rent and performing labour services upon the landlord's strips as the main form of rent payment. The rotation, which was rigid, was based upon either a two or three years' course—corn, pulse crops and fallow. The farmer and his family were almost independent of outside economic activities, making their clothing, household utensils, etc., and only acquiring by purchase or barter the two commodities not susceptible of home production, iron and salt.

Agriculture as practised in mediæval times was entirely traditional and varied but slightly in its general practice in the different parts of the country. There was therefore little demand for an agricultural literature, and the explanation of the appearance of these thirteenth century works is to be looked for in the increasing need of the landowning classes for money. The cost of living was rising and taxation was changing from a system based upon services and payments in kind to one based upon money. The landowners therefore were finding it

imperative to exploit the money-making possibilities of their estates, and hence a demand for books which would tell them how to farm profitably. Books to be circulated in those days had either to be passed from hand to hand or laboriously copied out by the pen. It is not to be supposed, therefore, that their influence was at all great. Two extracts from Walter of Henley will show that few ideas are really modern. He works out a cost account for wheat as follows: "You know surely that an acre sown with wheat takes three ploughings, except lands which are sown yearly; and that, one with the other, each ploughing is worth sixpence, and harrowing a penny, and on the acre it is necessary to sow at least two bushels. Now two bushels at Michaelmas are worth at least twelvepence, and weeding a halfpenny and reaping fivepence, and carrying in August a penny, the straw will pay for the threshing. At three times your sowing you ought to have six bushels, worth three shillings, and the cost amounts to three shillings and three halfpence, and the ground is yours and not reckoned."

This is followed by directions for carrying out an experiment in the yield of wheat seed as between that produced on the farm and imported seed.

"Change your seed every year at Michaelmas," he tells us, "for seed grown on other ground will bring more profit than that which is sown on your own. Will you see this? Plough two selions at the same time, and sow the one with seed which is bought and the other with corn which you have grown: in August you will see that I speak truly."

Sixteenth Century.—The agricultural community was dependent on Walter of Henley's treatise for three centuries. That it was fairly widely read is indicated by the number of copies still in existence. Miss Lamond, in her edition of Walter of Henley published for the Royal Horticultural Society, notices twenty-one copies in various libraries. This total may not seem large, but literature of this character, owing to the very fact of its practical utility, was specially liable to destruction. In the interval between the appearance of Walter of Henley's works and Fitzherbert's "Husbandry," which is the next on the list of agricultural publications, considerable changes took place in the organisation of English agriculture. The landlord, finding farming with bailiffs and compulsory labour an unprofitable operation, began to let farms to tenants who paid a rent in money or kind. Further, the growth of the woollen industry, a special feature of the period between 1450 and 1600, had created in certain parts of the

country, notably in the Eastern counties, a market for agricultural products, and in consequence a more commercial type of agriculture. The bulk of the farmers were still engaged in producing their own requirements, but a class was beginning to appear who grew food not only for themselves but, in addition, for the still small but increasing urban population. This growing commercialisation of agriculture was without doubt partly responsible for the appearance of a number of new works on agricultural subjects, and the introduction of printing in 1477 was destined to increase the influence of such works. Fitzherbert's book was produced in 1523 and by the end of the century had passed through at least twenty-one editions. It contains a discussion of the question of horses *v.* oxen as draught animals which is well worth quotation. He writes:—"It is to be knowen, whether is better, a plough of horses, or a plough of oxen, and therin me semeth oughte to be made a distinction. For in some places an oxe-plough is better; that is to say, in every place where-as the husband hath several pastures to put his oxen in whan they come from theyr warke, there the oxe-plough is better. For an oxe may not endure his warke, to labour all daye, and than to be put to the commons, or before the herdman, and to be set in a fold all nyghte without meate, and go to his labour in the mornynge. But and he be put in a good pasture all nyghte, he wyll labour moche of all the daye dayely.

"And oxen wyl plowe in tough cley, and upon hylly grounde where-as horses wyll stande still. And where-as is noo several pastures, there the horse-plough is better, for the horses may be teddered or tyed upon leys, balkes, or hades, where-as oxen maye not be kept: and it is not used to tedder them, but in few places.

"And horses wyl goo faster than oxen on even grounde or lyght grounde, and be quicker for cariage: but they be ferre more costly to kepe in winter, for they must have both hey and corne to eate, and straw for lytter; they must be well shodde on all foure fete, and the gere that they shal draw with is more costely than that for the oxen, and shorter whyle it wyll last. And oxen wyll eate but straw, and a lyttel hey, the whiche is not halfe the coste that horsis must have, and they have no shoes, as horses have. And if any sorance come to the horse, or (he) waxe olde, broysed, or blynde, then he is lyttell worthe. And if any sorance come to an oxe, (and he) waxe olde, broysed, or blinde, for 2s. he may be fedde, and thanne he is

mannes meate, and as good or better than ever he was. And the horse, whan he dyethe, is but caryen. And, therfore me semeth, all thynges consydered, the ploughe of oxen is moche more profitable than the ploughe of horses.''

The relative advantages of horse and ox labour were canvassed for the next three centuries, to culminate in a blaze of controversy at the end of the 18th century, followed by the rapid substitution of horses for oxen.

Fitzherbert, discussing the qualities to be looked for in store cattle, tells us: "Se that he have a brode rib, and a thycke hyde, and to be lose-skinned, that it stycke not hard nor streyte to hys rybbes, for then he wyll not fede.''

Passing on we come to Thomas Tusser, whose book, "One hundred points of good husbandry,'' subsequently enlarged to "Five hundred points of good husbandry,'' first appeared in 1557. The editors of the edition published by the English Dialect Society write: "If the number of editions through which an author's works pass be a proof of merit, as it certainly is of popularity, few writers of his time can enter into competition with Tusser. During the forty years from the appearance of the first edition of the 'One Hundred Poyntes' in 1557 to the end of the sixteenth century, no fewer than thirteen editions of his work are known to have been published. Yet all are scarce, and few of those surviving are perfect; a proof that what was intended for practical use had been sedulously applied to that purpose.''

The book is full of information on the agricultural conditions of the times—space allows of but two quotations. In a section headed "Corne harvest equally divided into ten partes,'' he gives us a rough idea of the distribution of the costs of corn-growing.

"One part cast forth, for rent due out of hand,
One other part, for seede to sowe thy land,
Another, part, leaue Parson for his tieth.
Another part for harvest, sickle and sieth.
One part for plowwrite, cartwrite, knacker and smith,
One part to vphold thy teemes that drawe therewith.
One part for seruant and workmans wages lay.
One part likewise for filbellie day by day.
One part thy wife for needfull things doth craue.
Thyself and child, the last one part would haue.''

In another section, "A comparison between Champion countaie and severall,'' he describes the advantages of enclosed

land and the disadvantages of the open fields with their scattered strips and common pastures and waste. One stanza reads :—

"More plentie of mutton and biefe,
corne, butter, and cheese of the best,
More wealth any where (to be brief),
more people, more handsome and prest,
Where find ye? (go search any coast)
than there where enclosure is most."

Thomas Tusser has sometimes been pointed to as an example of a "book-farmer" who failed miserably at practical farming and ended his days in poverty. There is good reason for regarding the latter point as inaccurate and consequently for modifying the description of his farming experiences. Tusser's will shows that at the time of his death he was owed £330 by his brother William, no small sum in those days, that he owned a copyhold of 7 acres and a rood in the Parish of Chesterton and had an interest in another holding from which he received a rent of 35s. annually.

In the last quarter of the sixteenth century appeared Barnaby Googe's translation, with additions, of the "Four Bookes of Husbandrie by Conradus Heresbachius" in 1577, and Leonard Mascall's "Government of Cattell" in 1596. Both these works enjoyed a considerable popularity and many subsequent editions were issued.

The disadvantages of the shallow ploughing of the time were drawn attention to by Barnaby Googe when he recommends night ploughing in hot weather in order to preserve the moisture. The growing impoverishment of the surface layer, especially in light soil areas, was making the application of manure of some sort imperative. The common system of farming was not conducive to the production of manure, and Googe recommends the growing and ploughing in of a crop of lupins as an alternative. This practice, though well known to classical writers, is not mentioned in any previous English work.

Leonard Mascall's "Government of Cattell," though in places entertaining and amusing, has little to recommend it. Shrewd sense is inextricably mixed up with grotesque nonsense, and a perusal of it leads one to sympathise with the attitude of the sixteenth and seventeenth century farmers to the recommendations of agricultural writers.

Other writers, of whom the most important is Sir Hugh Plat, bring the total for the sixteenth century to twelve. This figure

gives but an imperfect idea of the quantity of agricultural literature produced. Twenty-one editions of Fitzherbert's "Husbandry" are known to exist, but, the agricultural literature of this period is, bibliographically, almost virgin soil, and a careful investigation therefore is certain to bring to light fresh editions. The same may be said of the other writers of this period and a study of the quantity side might show the last quarter of the sixteenth century to be a period during which very considerable interest was manifested in the problems of rural economy.

Seventeenth Century.—Once started, the race of book farmers increased rapidly in numbers and in the seventeenth century attained to the respectable total of sixty.

Of these writers, the most prolific were Gervase Markham and Samuel Hartlib, but their work cannot compete in point of intrinsic value with Walter Blith's "English Improver," published in 1649, and John Worlidge's "Systema Agriculturae," 1669. The latter, though a fair-sized folio volume, passed through no fewer than six editions before the close of the century.

The keynote of these two works is improvement by means of enclosing, drainage, and better rotations, including the growing of leguminous forage crops, and that their suggestions did not bear fruit during this century is attributable, the writer thinks, to lack of confidence in the practical value of the ideas put forward by book farmers, to the conservativism of the smaller farmers, supported by the traditional routine of the open-field villages, and more particularly to the absence of an expanding market for agricultural produce. Population in the 600 years between the Norman Conquest and the end of the seventeenth century had probably not more than doubled, and agricultural change and progress had been slow in consequence.

Eighteenth Century.—The first half of the eighteenth century partakes of the character of the seventeenth, though signs of change are beginning to appear. These changes materialise in the latter half of the century, which in consequence is in strong contrast with the earlier period. A stimulus to agricultural improvement appeared on the scene and its influence was both immediate and widespread. The growth of population consequent upon the Industrial Revolution and the more than proportionate increase in the numbers of the town-dwellers made an increased production from the soil a matter of the first importance. This factor was reinforced by the almost complete severance of this country from sources of foreign supply as a result of the Napoleonic Wars, nor should the effects of the

accumulation of wealth made possible by the long period of internal peace and security be lost sight of.

The occasion produced the man, and Arthur Young gave to the English landlord and farmer such information, based mainly upon experience and observation, as enabled them to adopt the improved practices of the most advanced agriculturists.

Arthur Young stands at the head of a host of writers in the eighteenth century, and the real significance of this period in the history of agricultural development will only admit of accurate estimation when the literature of the period has been carefully studied both from the quantitative and qualitative side. Some idea of the volume of the literature of the eighteenth century may be gained from the figures for Arthur Young, one of a hundred writers; his contributions, including separate editions, are contained in approximately 250 volumes, few of which can be treated as mere reprints.

One of the best known agriculturists of this time was Robert Bakewell, of Dishley, in Derbyshire, whose work was mainly the improvement of live stock, and in this connection a document, the text of which is reprinted below, has recently come to light. It is interesting as establishing the truth of an historical rumour to the effect that at one point of his career Bakewell was on the verge of bankruptcy. Attempts to discredit this tradition have been made on the ground that no large sale of his stock could be proved to have taken place prior to his death. Here, however, is proof conclusive that the greatest of early pedigree stock breeders was at one time on the verge of financial ruin, from which he was only rescued by the generosity and public-spiritedness of many of the great landowners of the day.

To the NOBILITY, GENTRY and OTHERS,

The humble petition of Robert Bakewell, of Dishley, in the County of Leicester,

Sheweth,

That your Petitioner has for a Series of Years employed his Attention on a Plan for improving the Breed of Horses for Cavalry, Harness and Draught, as also of the Neat Cattle and Sheep.

That your Petitioner, in Pursuit of this Plan, had many difficulties to surmount, having the Prejudices of other Breeders to combat, and various Experiments to make, in order to ascertain which were the best kinds to breed from; and that such Experiments were attended with considerable Expence, and more Trouble than he can well convey a Sense of.

That your Petitioner apprehends he has brought all the different Kinds of Stock above-mentioned to a greater Degree of Perfection than has been done by any other Person, and thereby rendered important Services to this Country; and in this Opinion he hopes he is justified, by the best Judges having purchased from this Stock, at higher prices than from any other, and having sent them into the Counties of Bedford, Bucks, Cambridge, Chester, Cumberland, Derby, Devon, Dorset, Durham, Essex, Gloucester, Hereford, Herts, Huntingdon, Kent, Lancaster, Leicester, Lincoln, Norfolk, Northampton, Northumberland, Nottingham, Oxford, Rutland, Salop, Somerset, Southampton, Stafford, Suffolk, Sussex, Warwick, Westmoreland, Wilts, Worcester, York, into North Britain, Wales, Ireland, Germany, and Jamaica.

That your Petitioner has made considerable Improvements in Agriculture, Division of Lands, Watering of Meadows, &c.

That your Petitioner, in Consequence of the aforesaid Difficulties and Expences, as well as by many great and unavoidable losses, to the Amount of many Thousand Pounds, is rendered incapable of pursuing his Plan; and as a considerable Part of the Stock is soon to be sold, and probably will fall into the Hands of those who for Want of Experience, or other Causes, cannot be suppesed to manage it to the same Advantage, consequently little if any further Improvement can be expected therefrom.

But, if the Public would take this Case into their Consideration, and grant him such Assistance as would enable him to purchase the Whole, or the best Part of this Stock, he is fully persuaded he could be highly instrumental to the general Good of this Nation, by continuing in his late Line of the Breeding Business, and carrying it forward in such a manner as will be most conducive to the public Service; and he apprehends he could make as great Improvement from the State the Stock is now in, as he has done from the State of Stock in general at the Time he began this Business, an Object he thinks of great Importance to the Honour and Interest of the British Empire; for if it be allowed that the Increase of Herbage by Improvement in Agriculture is a real Advantage to the Public in general, he conceives the Improvement of Stock, so as to gain a greater Quantity and better Quality of Flesh from such Herbage, to be of equal, if not of greater Importance.

Your Petitioner therefore most humbly solicits, &c.

PARASITIC DISEASES OF PIGS AND THEIR PREVENTION.

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ONE of the most important and most profitable of the food animals is the pig; its economic position at the present day shows how essential it is that all unnecessary loss in growth and life should be avoided.

There is a popular belief that to be happy and contented a pig should live in filth and feed on dirty food prepared in an uncleanly manner: at least if not actually a belief, this is so frequently practised as to be almost accepted as such. Yet nothing could be further from the case. It is true that when food has to be bought in, the margin of profit is often small; and to make pig-keeping pay, a large amount of by-products is necessary for feeding. It is, however, far from desirable that these food-stuffs should be dirty, and it is even less desirable that the surroundings of the animal should be perpetually filthy.

The more spectacular of the porcine diseases are bacterial: Tuberculosis, Swine Fever, Swine Erysipelas and so on, are not directly due to dirt, although with all these diseases good clean conditions and proper feeding would save a considerable amount of loss, and good hygiene is essential for their complete eradication. In the case of the animal parasites, however, bad filthy conditions are even more responsible for their continuance, and the dirt of food and sty contains the active sources of infection.

It is not generally recognised how great is the loss due to parasites in pigs and how much can easily be done to prevent it by means of effective hygiene. The object of this article is to indicate to some extent the trouble caused in this country by these pests and how far steps may be taken to avoid or at least minimise the resulting loss in pigs and pork.

Round-worm (*Ascaris*).—The most important parasite of pigs in this and other countries is *Ascaris lumbricoides*. This is a large pinkish-yellow round-worm with three microscopic lips surrounding the mouth opening. The female is nearly a foot long and is more or less straight with a pointed posterior end. The male is slightly smaller and is bent posteriorly. This parasite is identical with the large round-worm of human beings, although it is possible that the pig form is a distinct strain which will not become adult in man. These parasites live

normally in the small intestine, although they have a habit of wandering into other situations, such as the stomach and bile-duct. It is extremely common in this country and may be seen in numbers practically any day in any abattoir where pigs are slaughtered.

The female, after mating, lays in the intestine millions of tiny eggs, which are carried to the exterior in the droppings. The eggs possess very thick shells, are remarkably resistant to all adverse conditions, and may remain alive for several years after leaving the body.

The eggs are laid in an undeveloped condition, and if accidentally swallowed at this stage do not infect the animal. After two or three weeks, however, if they have been under favourable conditions, and have received moisture, warmth and oxygen, a small worm embryo develops in each and may be watched (under the microscope) moving about in the egg-shell. It has now reached the infective stage, but it does not hatch until it is swallowed. It was once supposed that when the egg was swallowed, the young worm escaped in the stomach, and settling down in the intestine developed into a full-grown adult. Recent experimental work, however, has shown that its life story is much more complicated than this. The egg hatches in the intestine, it is true, but immediately the young worm (about one-hundredth of an inch long) burrows into the intestinal wall and reaches the blood stream. It is carried to the liver, and thence viâ the heart to the lungs. There it leaves the blood and passes up the windpipe to the gullet, is swallowed and reaches the intestine for the second time, about ten days after leaving it and about ten times its original size. It now settles down to the business of growing, and about ten weeks after being swallowed is producing eggs. The whole life-cycle thus takes about three months from the time the egg was laid until the worm is fully mature.

For many years, the *Ascaris* was known to be responsible for considerable damage among pigs, but it is only since this amazing life-cycle has been worked out that it has been understood to what an enormous extent it causes trouble.

In passing through the lungs, the young parasites cause great irritation and rupture many small blood vessels. If many are present at the same time, they give rise to pneumonia, which may prove fatal. Now it is a curious fact that in worm diseases in general, young animals are more susceptible than adults, and this disease is no exception. The young animals are attacked

at the most critical time of their life, and if they survive the attack, they do not continue to grow properly, but remain small and stunted. The growing period in a pig is very short, and if arrested it means a permanently small animal with a consequent serious loss to the farmer.

The fully grown worms also cause some damage. They bite the intestinal lining by means of their three-lipped mouth, and as they often change their position and are usually present in numbers, they cause considerable harm in that way. Moreover, they permit the entrance of harmful bacteria and may thus originate some disease which would not otherwise obtain a hold, while it has recently been found that the adults produce a poison which is probable responsible for a certain amount of anæmia.

The damage thus done may be considerable, but it is small compared with that done by the young worm in its journey through the delicate living tissue. The adult worm can easily be removed by suitable drugs—several are available—but there is no drug which will kill the young worms once they have entered the body and started to invade the blood stream. Here, however, a knowledge of the peculiar life-cycle has suggested an effective means of prevention, which has been used in America with the utmost success. The method consists of careful preparation before the birth of the young pig. It is easy to tell by means of the microscope if the pigs in a yard are infected. The small eggs are characteristic, even if one cannot definitely see any symptoms. A clean farrowing pen must be provided for the sow a few days before farrowing. By "clean" is meant absolutely free from Ascarid eggs. All litter must be removed and the floor and walls should be scrubbed with boiling water and soda lye, or a carbolic disinfectant: plenty of boiling water should be used. The pen must not open to the yard, as while the sow is in it, she must not be permitted to have access to infected spots—as the yard is sure to be. The sow, before being placed in the pen, must also be cleaned—especially the udders—with soap and water, as eggs are liable to stick to the skin, and she should, if possible, be freed from adult worms. It would obviously be futile to employ a clean pen, if the sow brought in and fed to her young, millions of eggs.

After farrowing, in about 10 to 14 days, the sow and the litter are removed in a cart direct from the sty without touching the yard, to a temporary pasture to which pigs have not had

access for several years and which is definitely separated from the styes. Water should be supplied by pipe or in pails (not as ponds) and no other pigs should have access to this pasture. Here the pigs should be kept until about 4 months old, when they may be safely moved back to the old sty. They will acquire an infection there, it is true, but it will be too late to interfere with the growth, and there will not be the loss due to pneumonia and stunted growth which would otherwise have occurred. This system may require adaptation to meet local circumstances, but the important point is to raise young animals in a free spot free from Ascarid eggs, until they are sufficiently grown to be more or less resistant. Particularly to be avoided are permanent pastures. The extra trouble involved in this system is more than repaid by the decrease in infant pig mortality.

Husk or Hoose.—Another genus of worm parasites of considerable economic importance is *Metastrongylus*, the cause of the familiar " husk " or " hoose " in pigs. Two species are known in this country, both very similar and both frequently found in the same animal. The females measure about 1 to 2 in. long, the males being half this length. Both species are very slender and live in the branches of the windpipe. They consequently cause a verminous bronchitis, characterised by a cough, which may develop into pneumonia. As in the previous species, they are much more serious parasites in young animals than in adults.

The life-cycle is still unsolved. The adult female lays eggs which hatch in the lungs and the larvæ ascend the windpipe, are swallowed and reach the exterior in the droppings. The course of their subsequent development is unknown, and consequently a definite scheme of attack—such as is used against *Ascaris*—is not at present available. Prevention is thus so far simply a matter of hygiene. Pigs reared under healthy surroundings are much less likely to become infected: and if they should contract the disease, are much more likely to recover completely.

Other Round-worms.—There are three other species of round-worms not uncommon in pigs in this country, which if of less clinical importance are yet of considerable interest.

The first species is a very minute, pinkish, hair-like parasite—a relation of the Stomach-worm of sheep—which lives in the stomach of pigs and is called *Hyostrongylus rubidus*. The female is only about $\frac{1}{4}$ in. long—the male is even smaller—and is scarcely visible to the naked eye. It has generally been

associated with a certain amount of inflammation of the stomach, but has recently been found in healthy pigs. The female lays numerous small eggs, which pass to the exterior in the droppings, and after a short time hatch. The minute embryo which emerges, feeds, grows, moults and in a few days has reached the infective stage. The embryos live in damp situations, and if at this stage they are eaten by the pig they continue their development into adult worms. In this case, prevention is again a matter of hygiene. The infected manure and litter should be removed to a place inaccessible to pigs.

The second species, a close relation to the parasite of " Pimply-gut " in sheep, goats and cattle, lives in the large intestine. It is called *Oesophagostomum dentatum*. Both sexes are under 1 in. long, but are white stoutish worms which are visible to the naked eye. They do not appear to cause nodule formation on the gut wall, as do the forms in ruminants, but they are responsible for diffuse centres of inflammation. So far, however, they have not been associated with any well-defined clinical symptoms. Their life cycle has not been fully worked out; but it appears to be similar, in the free-living stages, at least, to that described for the previous species. They are, however, rather more resistant to adverse conditions, such as drying, and infection would in consequence be more difficult to prevent.

The Whip-worm.—A more common species in pigs in this country is the whip-worm (*Trichuris suis*), which lives in the cæcum. These are small whitish worms with a thin thread-like anterior portion—hence the popular name of " whip-worm." The thin anterior portion is threaded through the lining of the cæcum and the parasite feeds on the juices thus found. The posterior portion—straight in the female, coiled in the male—lies free in the intestine. Directly, these parasites seem to do little harm; but indirectly, they may be the means of admitting pathogenic bacteria. Their life history is unknown.

The round-worms described above all occur in this country, and all do more or less damage. Many other species are, however, found abroad, some of them in temperate climates and under conditions which might permit their living in this country should they be introduced.

Trichinosis.—The most important of the Trichinæ is *Trichinella spiralis*. The adult parasite is a very minute worm, living in the small intestine of the pig. It does not lay eggs as do the other species, but produces living larvæ. Some of these pass to the exterior in the droppings, but others reach the blood

stream, and are carried to the muscles, where they encyst. They remain there until they are eaten by some flesh-eating animal, when they develop to maturity in the intestine and repeat the circle. The natural host of this parasite seems to be the rat, but man may be infected, with very serious results. The encysted infected forms in pork are not as a rule visible to the naked eye, and in some countries a special meat inspection staff is employed in order to detect their presence. Fortunately they seem to be absent from this country now, though two years ago some cases were reported from Wales.

Liver-Fluke and Tape-worms.—The flat-worms in the pig are of less importance than the round-worms.

The *liver fluke* of sheep will also live in the pig, but economically is not of the same importance as in the case of sheep. It is nevertheless wise to remember that the pig is a suitable host, and may act as a reservoir for the parasite. The fluke passes part of its life history in a small fresh-water snail, which can of course be infected by embryos hatched from eggs passed by the pig.

There are no adult *tape-worms* found in the pig, but the pig is the host of a number of intermediate cystic stages of the tape-worms of man and the dog. The human tapeworm (*Tænia solium*) finds its intermediate host normally in the pig. Fortunately, this parasite is now very rare, and appears to be absent from Britain. A more important cyst is the well known Hydatid—the intermediate stage of a very small tape-worm in the dog. This is one of the most important parasites in this country—but from the Public Health rather than the economic point of view. Man may be infected by swallowing one of the tape-worm eggs passed by the dog, and the Hydatid will develop in him with, generally, very serious results. The importance of the pig is therefore rather as a reservoir host for the infection of the dog and subsequently of man. The cyst is slow growing, and owing to the usually early slaughter of pigs, it seldom reaches large dimensions in this animal. Cases are on record, however, where the liver of a pig has been found to weigh over forty times its normal weight owing to the presence of these cysts.

Skin Parasites.—*Lice.*—Only two parasites of the skin of pigs are of importance. The better known and common one in this country is the Pig louse (*Hæmatopinus suis*). This is the largest of the lice of the domestic animals—it is nearly $\frac{1}{4}$ in. long—and lives only on the pig. It is a most vicious blood-sucker, and attacks animals of all ages and in all countries. It

is most frequently found near the ears, on the breast and on the inner surface of the elbows. It is very common in Britain. It causes intense itching, and a serum which oozes from the spots where it has punctured the skin causes a mange-like scale. In some parts of the country it is an extremely serious parasite. Its presence interferes with growth and fattening, and young pigs often die from the loss of blood and the extreme irritation. The female attaches her eggs to the bristle by means of a viscid cement which she secretes. Young forms, resembling the adult in shape, emerge in about a week. They moult several times, and in about a month are sexually mature. During the whole life they do not leave the body except accidentally.

In the treatment of this animal by means of one of the various parasiticides applied to the skin as dip, wallow, spray or hand dressing, it is important to remember that the application should be repeated at least three times at intervals of seven to ten days in order to destroy the young forms which emerge from the eggs not destroyed by the insecticide. At the same time as the animal is treated, the sty must be disinfected, while the bedding should be burned. A useful preventive measure is the occasional addition of 5 per cent. creolin to the wallows. This simple measure has been found extremely useful in practice.

Mange.—Sarcoptic mange in pigs is not common in this country—the condition resembling it clinically being most frequently due to lice. It is becoming increasingly prevalent in America, where it causes serious losses. The parasite is closely related to the mite causing Scabies in man. The adult female lives in a burrow in the skin, and by the irritation of her presence causes the exudation of serum with the production of the familiar scab. Her eggs are laid in this burrow. The eggs hatch, and the young mites reach the scab, where after twice moulting they become adult, and commence a fresh burrow. It is estimated that in about three months, a single female will give rise to a million and a half mites. They cause great itchiness, and as the pig rubs itself to ease this, the scab gets broken off and the mites are disseminated. They are generally found in the head region of the pig, but if unchecked they spread all over the body. Once established, the mange mite is a very serious parasite, and may cause the death of the animal. The skin too, is rendered useless, even if the animal is cured.

In this case treatment should be repeated three times at intervals of five to eight days in order to destroy the forms newly-emerged from the eggs.

General Conditions.—The most important of the parasitic infections discussed above, in this country at least, are those due to *Ascaris*, lungworms and lice, and their greatest effect is felt in the young animals. The greatest losses in young pigs are apparently due to diseases caused by defective feeding—such as rickets—or by animal parasites, and both sets of conditions are not difficult to remedy. It is an axiom in sanitary science that no animal can exist in a more or less enduring contact with its own body wastes without the risk—sooner or later—of an outbreak of disease, and owing to the prevalence of these three parasites in Britain, this risk becomes a certainty, and the mortality —especially in young animals—is extremely high. On the other hand, in well-kept, hygienic styes, parasitic disease can be kept to a minimum and the result is immediately apparent in increase of condition and decrease of mortality. Adequate drainage is essential, and no pools should be allowed to exist to which the pigs have access. Feeding from the ground is to be avoided, and the provision of raised sleeping quarters which the pigs learn not to defile is desirable. Manure removal should be thorough and frequent, and the pigs should not have access to the manure beds. Cleanliness must not be superficial, as this gives merely a false sense of security and is not true economy. Disinfection is also useless if rubbish and infective litter are left in the pen.

In eradication of parasitic worms, it is well to remember that while treatment is the province of the veterinary surgeon, prevention through hygienic measures can only be carried out by the stock-breeder. Patent medicines—especially those mixed with the food—are often useless in removing parasites, and their use is to be deprecated.

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OATS : VARIETIES AND CULTIVATION.

ALTHOUGH the depredations of frit-fly* have done much to discourage the growing of spring oats, their importance is still great. Owing to the large number of varieties on the market, farmers find some difficulty in deciding which are likely to be most suited to their conditions.

Varieties of Spring Oats.—Generally speaking, in England and Wales on the best types of soil, Victory and Abundance are likely to give good results; it is probable that the latter gives a slightly heavier crop, but it is not so strong in the straw and is liable to "lodge" if following a heavily manured crop. Crown oats also yield well on good land. Supreme (black)† and

* *See* Leaflet No. 202, "The Frit Fly."

† Except where otherwise stated the colour of the husk is white.

Golden Rain (yellow) do well on similar soil and are to be recommended where conditions are conducive to late ripening, while Yielder often does particularly well on exceptionally heavy land. In Wales, Record has been found suitable on good quality soils when seed mixtures are sown under the oat crop. The Potato oat is a popular variety on good land in the hilly districts of the North-West of England where rainfall is high. It is not a success, however, in other parts of the country. For soils of moderate fertility Black Tartarian (black) is to be recommended, but where late ripening is anticipated Waverley, Record or Black Bell III (black) may give better results. Black Tartarian does not tiller well, but has been found to give good crops on poor land in coastal districts. If broadcast on an old broken up ley, as is often the practice in Wales, it is particularly susceptible to the depredations of wire-worm. Where soils of under average fertility are in question, Black Tartarian is the most hopeful variety. In Wales and Herefordshire, Radnorshire Sprig has done well under these conditions. Ceirch du Bach and Welsh Strigosa are particularly adapted to high-lying land in Wales, the latter giving crops on land of the lowest productivity. Cornish Black, an oat very similar to Ceirch du Bach, is successful under similar conditions in Cornwall. The two Welsh varieties are invariably chaffed without thrashing.

Cultivation.—It is essential for successful growing of spring oats that they should be sown early on a good seed-bed. For early sowing 3 bushels are sufficient if drilled. If broadcast 4 to 5 bushels are required. For later drilling 4 bushels should be seeded. Crops drilled in England in February or the first half of March, have usually sufficiently developed by the last half of May to be practically immune from the attacks of the first frit-fly broods, which are then at their height. In unfavourable seasons, small top dressings of nitrate of soda or nitrate of lime stimulate growth, and thus may bring the plants past this critical period. If sowing is carried out later than the middle of March, heavy seeding may help to compensate for frit-fly damage, but generally it is better to substitute barley under these circumstances. On land where early sowing is usually impossible it is wiser to grow winter oats instead. These latter have the additional advantage that they usually produce a heavy crop of high quality. Winter oats are also to be preferred to spring oats on land where charlock is prevalent.

Varieties of Winter Oats.—Three varieties are commonly grown, namely, Grey Winter Oat, Black Winter Oat, and Bounti-

ful Black Oat. In deciding which to grow, farmers should be guided largely by local experience, for while all may grow equally well in any particular district, there is sometimes a keener local demand by merchants for one than for another. The black varieties possess somewhat stronger straw than the grey variety, and might generally be given the preference where oats are subject to "lodging." The Grey Winter Oat, however, appears to be the most hardy of all the winter varieties. Black Winter Oat is more liable to shed its seed than the grey variety, and should be cut before it is dead ripe. In no case, perhaps, is the straw of winter oats so nutritious as that of the finer spring varieties, but when chaffed and mixed with cake and meal it is readily eaten by stock. A white variety, Marvellous, has recently been introduced, which, possessing stiff, upstanding straw, has given big yields following mild winters on rich land. The grain is bigger than that of the commoner winter varieties, and Marvellous should therefore be sown at a relatively thicker rate.

Soil and Cultivation.—Winter oats are suited to a wide range of soils. They can be grown successfully on soils too light or too poor for wheat, and they prevent such soils from "washing" in a wet winter. Further, they can be taken as a second corn crop, provided the land is clean. They must be sown early, preferably in September, so that the plants may become well established before cold weather sets in. (They may also, however, be sown in spring—see last paragraph, p. 434.) Winter oats very seldom suffer appreciably from the attacks of frit-fly, since, by the time the flies appear in spring, the oats have ordinarily grown to a size at which they are not susceptible to attack. They may, however, be severely injured by over-wintering frit maggots when the crop is sown after a ley containing grasses (especially rye grass), *which was not ploughed until autumn or winter.* In such a case the maggots migrate from the ploughed turf to the young oat plant; the remedy is to plough the ley after the hay crop is taken and sacrifice the aftermath. Bountiful is, if anything, the least hardy of the three common varieties, and tillers least. It is best adapted to the mildest districts, and requires somewhat richer land than the others; it stands up well.

Unless the land is thoroughly clean, weeds are favoured by a longer growing period than usual, and may seriously reduce the crop. About 3 to 4 bushels per acre should be drilled; for broadcasting 4 to 5 bushels are required. The earlier the sowing and the cleaner the land the less the quantity of seed necessary. Winter oats are generally ready for cutting from ten days to a

fortnight before other corn crops. This enables the land to be prepared sooner for the following crop, a point of some importance when farming is conducted at high pressure. When taken as a second straw crop, artificial manures will generally be necessary —say 2 cwt. superphosphate and 2 cwt. kainit at seed time, followed by a top dressing of $\frac{3}{4}$ cwt. sulphate of ammonia or 1 cwt. nitrate of soda in the spring.

Suitability for Spring Sowing.—Experience in Derbyshire seems to indicate that Grey Winter or Black Winter Oats sown about the end of March, are more reliable than the commoner spring sorts, especially on grass land just ploughed out. This practice is only advisable in early districts, where the strong tillering habit of the varieties named minimises the effect of the frit-fly attack. Bountiful was originally grown chiefly as a spring oat.

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HOME CURING OF BACON.

E. PRATT SADDINGTON.

Type and Treatment of Pig.—In the production of prime bacon one must begin well, and it is essential to have in mind the importance of choice of pig, housing and feeding. Careful attention in this way means very much toward success, whilst neglect brings probable or certain failure. The animal should be of the type calculated to give satisfactory results by way of growth and quality of flesh in the right position, with good proportion of lean, there being few people who really enjoy fat bacon, and when fat is excessive it is often a source of great waste.

Many consider the pig to be a dirty animal and treat it accordingly, but actually it thrives and gives best results from every point of view, when kept under clean conditions. The piggery should be dry, roomy, light and well ventilated, but the animal must not be exposed to strong sun or to draughts.

Moderate exercise is beneficial, preventing cramp and other ailments. Daily cleansing and an occasional lime-washing of the sty will minimise the unpleasant odour generally associated with such buildings, and which often acts as a deterrent to the keeping of pigs.

Food should be as fresh as possible, clean, of suitable proportions and given at regular intervals, in quantities readily cleared up. It is distinctly wrong to allow accumulations of stale food in the piggery or elsewhere.

Highly fermented, strong-smelling foods are likely to have a bad effect upon the appetite and health of the animal and consequently upon the bacon. Fish-meal must be of best quality and used with discretion or the flesh is apt to be tainted. Vegetable oils in too large proportion produce soft, oily fat with a tendency to turn yellow.

For commercial purposes the carcass should not weigh more than 200 lb., but for home use a rather larger carcass may, under some circumstances, be found convenient, although it is not economical to keep a pig longer than seven to eight months, since quite 3½ lb. of meal is required daily for maintenance alone.

Slaughtering and Dressing.—The best time for slaughter is from November to February, when flies are less active and weather of more suitable temperature. The slaughter-house should be clean, and situated at no great distance from the piggery in order to avoid undue excitement when transferring the animal. It is fairly common knowledge that, if the pig is in a high state of perspiration at the time of slaughter, curing may be difficult.

Accumulations of dust and rubbish where flies may congregate should be removed. The carcass may readily become tainted from drains or foul odours of any description. If possible a current of clean air should pass through the slaughter-house. A competent man should be chosen to carry out the actual slaughter, dressing and cutting up.

When it is decided to convert the carcass into bacon, the pig must be fasted for twenty-four hours, but its discomfort may be lessened by allowing it plenty of clean water.

When being taken from the sty the animal must not be beaten, bruised or roughly handled in any way, and twisting or jerking of the legs should be carefully avoided. Bruised flesh does not cure, and hams frequently go wrong because the joints have been injured. Even a small bruise will cause accumulation of blood, which develops an unpleasant odour, and surrounding parts quickly become tainted.

A plentiful supply of both cold and boiling water is necessary when scalding, and clean, dry straw if it is intended to singe. The use of too hot water blisters and discolours the skin, as does the flame when unskilfully applied, so that care is essential if one would have bacon of good appearance. After dressing the carcass should be allowed to hang until cold, but

not longer than 24 hours after scalding, or curing may be indifferent.

Methods of cutting up vary. Many take out much of the lean for the making of pies, sausages and other tasty dishes, but this is unwise as it leaves too large a proportion of fat for bacon. All trimmings can be utilised, so that no rough, irregular pieces should be left on the bacon. The carcass is easier to handle if the hams are cut out and dealt with separately, but there is more cut surface, which means additional waste and shrinkage.

Curing.—The place where curing is effected must be clean, cool and free from flies. It is well to turn out the apartment thoroughly and lime-wash, where possible. There must be no perceptible odour from drains, nor must strong-smelling foods, such as fish or onions, be permitted in the vicinity of the bacon. A salting trough or tub is the most practical thing, but when this is not available a clean board, shelf, table or brick thrall such as is found in most cellars and dairies would serve the purpose for dry-salting. For hams only earthen vessels are used. Metal utensils are unsuitable.

Ingredients should be of the best quality. Salt should be pure, fine and dry, and that prepared for table use is not recommended for this purpose. Saltpetre should also be pure, fine and dry. It is used to preserve the red colour of the lean, and is, therefore, especially useful in the ham and shoulder. When applied in large quantities it hardens the meat, but correctly used is decidedly helpful. Sugar prevents hardening and shrinking of the fibres, and gives flavour.

Bay salt is considered less harsh than the ordinary kind and is sometimes used in equal quantities with, but never wholly taking the place of. common salt. Salt should be prepared by drying and crushing it into fine powder. Saltpetre is better purchased from a reliable chemist, who will grind it, and, as far as is possible, will guarantee its purity.

The best Demerara sugar is preferable to the common brown variety. The recipes for curing are numerous and varied, but the following are simple and give good results. No great skill is necessary, but cleanliness, accuracy in weighing out ingredients, thorough rubbing of all parts until the surface feels slightly moist, and general attention to detail are essential to success.

(1) For every 20 lb. of meat allow $1\frac{1}{2}$ lb. to 2 lb. salt, 1 oz. saltpetre, $\frac{1}{2}$ lb. Demerara sugar. Rub the meat with salt only and leave the cut or

meat surface uppermost until next day. Drain away blood and moisture. Rub thoroughly, especially the ham and shoulder, with saltpetre, then with sugar and salt mixed, repeating the rubbing daily with sugar and salt until all is used, which will be in three to four days. Turn the bacon each day during the rubbing period.

Leave for three to four weeks, turning once weekly, and pouring the liquid over the bacon frequently if salting in a vessel where it accumulates. If a board or shelf is used this cannot of course be done.

Hams require four weeks and if they are cured in the side the whole must be left for that length of time. When curing is complete the next thing is to prepare for drying. With clean, cold water, rinse away all surplus salt, wipe with clean, dry cloths, scatter pepper freely around bones and in places where flies are likely to attack, and hang to dry in a warm room, but not too warm or the bacon will rust. To keep off dust whilst drying it is well to cover with muslin or even loosely with paper.

In about three weeks it should be dried sufficiently. It should be regularly dry and firm all over, but not hard and as unbendable as a board. The odour should be mild and pleasant. Place in calico or hessian bags and store in a cool, dry, well-ventilated room. It is better to suspend separately and not to place one side upon another in boxes or otherwise. Examine occasionally. If soft damp patches appear it is not keeping as it should, but this is not a common occurrence unless through neglect. If there is reason to doubt the keeping quality of ham or bacon plunge a knitting pin or thin sharp knife to the bone, draw it out, and the odour which clings to it will indicate whether the bacon is good or otherwise.

Some object to the flavour of sugar and prefer salt and saltpetre only. The latter make very good bacon, which cures and keeps well, but is inclined to be harder than when sugar is employed.

(2) For every 20 lb. of meat allow 2 lb. salt and 1 oz. saltpetre. Rub thoroughly, both skin and cut surface, with saltpetre, then with salt. Place one side upon the other with a good sprinkling of salt beneath, between and on the top, and leave for three to four weeks, turning the bacon weekly. The hams usually require four weeks and if cured in the sides the whole must be given that time, otherwise the bacon may be removed and the hams left a week longer. Drain away dissolved salt. When curing is complete, wash, to free it from surplus salt, wipe with clean absorbent cloth, and hang to dry as before directed.

Head and Feet.—The head and feet should be cured in the same way as the sides and may be placed in the same receptacle, but careful watch must be kept as the offal occasionally does not cure well, and should this happen, the bacon would be tainted by contact. After curing, the chaps, which are the lower part of the head, may be dried and kept for months, but the other parts are better cooked within three weeks. They make excellent brawn.

Smoked Bacon.—If smoked bacon is desired and no properly constructed room is available, there are places where this can

be done for a small charge. A room may be improvised, but a suitable building must be chosen. The walls and floor must be fireproof. After the bacon is cured instead of hanging to dry in the ordinary way the sides are suspended from the roof of the building. Upon the floor is placed a layer of clean, dry straw, and upon this, to the depth of three inches, a layer of sawdust. The straw is set alight and the sawdust smoulders, giving off the requisite smoke, in which the bacon should hang. This must be kept going continuously for from several days to a month according to the flavour desired. If only a mild smoking is required a few days in the room is sufficient, but the bacon must be thoroughly dried before storing, as in the case of plain curing.

The sawdust must be clean and dry and preferably from oak; that from the resinous woods is unsuitable.

The lower-priced, inferior smoked bacon one finds on the market is flavoured by immersing in a " smoke " bath, but this method is not recommended. If properly handled bacon will keep good a year or longer, and it should not be cooked under three months from the time of slaughter, although some really enjoy it when it has just finished drying.

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A BIRD'S-EYE VIEW OF CANADIAN FARMING.

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THE following notes were compiled in the course of a tour with the British Association for the Advancement of Science during the summer of 1924, and may be of interest as giving some idea of the conditions of farming and the methods adopted in Canada.

Agricultural Area.—The total area of Canada is in the neighbourhood of 2,300 million acres. This is larger than the United States of America, and more than sixty times the size of England and Wales, but owing to extensive regions which are not suitable for agriculture, the area which is fit for cultivation is estimated to be less than 30 per cent. of the whole. Small as this percentage may seem, it comprises some 631 million acres, of which not more than 10 per cent.—an area rather less than twice the size of England and Wales—has so far been brought into an improved condition, so that the possible development of Canadian agriculture is very great.

This agricultural zone may be divided approximately into two main parts (1) that which lies east of Lake Winnipeg, a well-wooded country, which possesses to-day a form of farming similar in many respects to our own, and (2) the west, the great wheat-producing prairies, which have exceptionally fertile soils of dark loam, varying in depth from one to ten feet.

Sixty-four per cent. of the total cultivated area is to be found in the three prairie provinces of Manitoba, Saskatchewan and Alberta, whose plains therefore constitute the largest agricultural section of the country, and of the $36\frac{1}{2}$ million acres of farm lands to be found there, at least 22 million acres are devoted to wheat, a figure with which the $1\frac{3}{4}$ million acres of the same crop in England and Wales can hardly be compared.

Agricultural Development. — Canadian agriculture has advanced at a phenomenal rate. A single lifetime there has seen what it took centuries for our own country to accomplish. First the grazier, then the cereal grower, and later the rotation farmer. The tendency is for the latter to move westward in the wake of the wheat zone, and thus it is found that Manitoba has already fallen to third place in the matter of wheat production, and is now making great strides in dairying, poultry farming, bee-keeping, etc.

The increase in wheat production is therefore a net gain, representing the balance between the encroachments of rotation farming from the east on the one hand, and the breaking of virgin soils taken over from the west and north on the other. Although wheat is now the main crop in the country, it is equalled in average by the combined acreages of oats, barley and rye, which shows that in Canada farming and wheat production are by no means synonymous terms. About half the total value of all the farm products of the country is represented by field crops, the remaining half being made up, in order of importance, of live stock, milk, butter, together with cheese and cream, eggs, vegetables, fruit, maple sugar and syrup, wool and honey. The high percentage of field crops is mainly accounted for by the enormous quantities of wheat grown for export, the record being reached in 1923, when more than 400 million bushels were produced.

These figures give a fair indication of the powerful influence which the West exerts in the general scheme of the agriculture of the country, though, as might be expected, the older eastern provinces, Quebec and Ontario, easily hold the lead in the matter of horses, pigs, meat products, eggs, butter and similar commo-

dities, a good deal of which helps to satisfy the ever-growing demands of the more populous United States.

Growth of Population.—It is interesting to note that, whereas both the urban and the rural population of the West has risen by leaps and bounds, it is only the urban population which has increased in the east of late years. It is not difficult to assign as a reason for this, that, apart from the steady flow of immigrants to the West, the farmers of eastern Canada are moving on to the prairies to take up corn-growing, as is evidenced by a comparison of the figures for cattle, which have hardly increased at all in either east or west during the same period.

The population of Canada is essentially fluid, and this applies not only to the Dominion but to the whole North American continent. A great deal is heard about the loss of population owing to the drifting down into the United States of many who hope in this way to improve their lot, but not so much is heard of the counter movement from south to north, which is a very real factor in the situation, and is due to some extent to the advantages which the farmer of the Canadian West has over his more southern neighbour. Briefly, these advantages are that the Canadian prairies give a higher yield of better quality wheat than the United States, while land values, rents and interest burdens are lower, and freight rates are less. When, in addition, it is remembered that only about one-tenth of the cultivable area has as yet been brought under the plough, it is undoubtedly true that Canada offers great opportunities to anyone of spirit and enterprise, who is prepared to take a share in developing those vast resources.

To become a prairie farmer it is by no means necessary to embark on an extensive holding. The Dominion lands, from which the demand for new farms is largely met, comprise some 150 million acres of potential farm lands, and these are divided into sections of 640 acres each. A quarter-section, of 160 acres, forms the unit which is granted to settlers by the Department of the Interior, and thus we find that the average holding is just over 150 acres, and only 18 per cent. of the farms in the country are more than 200 acres in extent.

The Eastern Provinces and British Columbia.—The agriculture of the eastern provinces approximates more nearly to European methods than to those of the prairie provinces. Potatoes, poultry, dairying and stock raising are the chief concerns of Prince Edward Island; fruit growing of Nova Scotia; and stock raising, dairying and poultry of New Brunswick. Practically

every form of mixed farming is to be found in Quebec, whilst the backbone of Ontario is the dairy industry, although stock raising, tobacco growing, sugar beet and flax all receive due attention. Mention should also be made of the wonderfully fertile Niagara belt, with its complete service of electric trains, where some of the choicest fruit in the world is grown.

In British Columbia, a real home from home for the British settler, the chief agricultural interest is centred upon fruit, with poultry, butter and cheese, hops, honey, vegetables, flowering bulbs, goats and rabbits as additional flourishing industries.

The West: Rotations versus Continuous Cropping.—As far as the West is concerned, a different set of factors is met, but even there it is rapidly coming to be realised that the introduction of rotations is the only way of getting a steady profit from the land. It is found already that continuous cropping with wheat, with just sufficient bare fallow to combat the deficiency of moisture, is yielding to some such rotation as wheat, wheat, barley or oats, seeds (first year for hay, second year for pasture), and then wheat again, whilst hoed crops are now by no means unknown on the prairies.

Generally speaking, however, the continuous growing of grain has not progressed so far as to reduce the yields seriously, though experiments have shown that a rotation of two years of wheat followed by one year of fallow has resulted in a decrease in some prairie soils of 30 per cent. of the nitrogen in 20 years.

The controlling elements are still such matters as rainfall, weeds and pests, and, as has been indicated, the one stand-by of the farmer in his endeavour to increase the soil moisture has been the summer fallow. This, however, is by no means a desirable method as it undoubtedly leads to the destruction of the valuable soil fibre, and allows drifting and loss of surface soil. It is disappointing to find in the morning that some of the best of your farm has blown on to your neighbour's holding. Moreover, the fallow may lead to a loss of nitrogen and organic matter in many cases greater than the normal amount taken out by a crop. In fact, it counteracts the one great advantage of the long and severe winter, which locks up the nitrogen supply in the autumn and only liberates it in spring and summer, when there should be a crop of some sort to make use of it.

There is yet another way of combating the evil effects of drought, and that is by irrigation, and already a great tract of land, three-quarters the size of Wales, is being lucratively farmed in Alberta under the Canadian Pacific Railway Bassano Dam irrigation scheme.

A Labour Difficulty.—There is one problem of the West which at present defies solution, and it is an important one. Any system of farming, whose sole aim is to produce a single cereal crop which only comes to maturity once in the course of a year, must in the nature of things give rise to a very fluctuating demand for labour. From the beginning of harvest until the thrashed grain has been delivered to the local elevator, or put on rail, the labour which is available locally is swept off its feet. In order to cope with the volume of work, encouragement is given to the temporary migration from the eastern provinces and from the United States of about 25,000 harvesters each year, and in 1923 this number was supplemented by 12,000 men brought over from the British Isles. At the end of the season, when the farm work practically closes down for 5 or 6 months, the farmers have no choice but to turn away most of these extra hands. It is impossible to see that they could act otherwise under the circumstances, but this does not obscure the fact that it is an economic weakness in the business of wheat production as at present organised.

Live Stock.—What would bring the prairies undoubted benefit would be plenty of manure, and manure pre-supposes live stock, and live stock means labour, but the difficulty about live stock is that hitherto it has had to be housed in winter. It is hard to imagine a farmer housing his ewe flock for six months at a time, but that is what happens out there, with the result that most farmers do not bother with a ewe flock at all. Ontario and Quebec each carry more sheep than all the other provinces added together. Recently, however, in the east and as far west as the Red River basin about Winnipeg, the experiment has been successfully tried of letting cattle run loose in the bush with rough shelters to prevent their falling victims to the snow squalls. In addition the Department of Agriculture have set on foot serious experiments in crossing the domestic breeds of cattle with the bison in an endeavour to evolve a breed which shall combine the utility points of the former with the hardiness of the latter. Of the domestic breeds there are something like fifty in the Dominion, but education has had the salutary effect of bringing some few of the better breeds well to the front. As far as dairying is concerned, Ayrshires and Holsteins appear to be the most popular breeds at present.

As regards winter keep, roots are hardly grown at all. Silage, usually of maize or sunflower, is the staple fodder in winter, and of this and of good hay there need be no shortage.

At present the farmer usually yields to the temptation to grow wheat, and nothing else, but this is changing, as may be judged from the fact that the prairie provinces, besides providing for their own internal needs in the matter of dairy produce, are now actually exporting cheese and butter in increasing quantities.

Wheat Improvement.—As regards the improvement of the wheat plant itself much remains to be done. The period of the year during which vegetable growth is possible is much shorter than in some other temperate climates, so that the farmer is engaged throughout the summer in a race against time. Especially is this so for the prairie farmer, who relies so much on a single crop, and who is handicapped by the freezing of the great lakes and the resulting difficulties of transport. The energies of the plant breeder have been largely bent in the direction of discovering early-maturing varieties.

The answer to the fundamental question, " Can wheat be grown in the West at all? " was found in 1840 after some devastating experiences, in a chance packet of wheat from Scotland, from which sprang the famous Red Fife, which was destined to cover the whole of the West. This saved the situation and left no doubt that the settlers could provide for their own sustenance, but an earlier maturing variety was still required, especially for export purposes. In 1903 Dr. Charles Saunders planted an experimental plot at the Dominion Experimental Farm at Ottawa with a haphazard cross between Red Fife and Hard Red Calcutta, and from this plot has sprung the Marquis wheat, which matures earlier, and yields better than Red Fife, and which has practically displaced all other varieties. In 1923, 500 million bushels of Marquis, all of which originated from a single seed on Dr. Saunder's plot, were raised on the North American continent.

This is a large figure, but even so the average yield of wheat in Canada stands in the neighbourhood of 17 bushels to the acre, as compared with 31 in this country. This is to be explained in part by a climate which only allows of spring-sown wheat. It is true that winter wheat can be grown in some localities, but the acreage devoted to it only represents two-fifths of 1 per cent. of the whole wheat acreage. Even so there is no doubt that the spring wheat yields can and will be increased in the future, as they have been in the past, and in this connection it will be interesting to follow the career of the Reward wheat, which has just been derived from Marquis at the Dominion Farm, and which gives every promise of being a distinct improvement on it.

Other difficulties connected with wheat-growing arise from drying winds, early autumnal frosts, hailstorms and particularly

from the depredations of the black stem rust, a disease which mercifully is unknown in this country, but which causes incalculable losses in the West. Could the scientists evolve a strain immune to this pest, as they have hopes of doing, the yield of the prairies would be vastly increased without further expense.

Machinery.—As far as machinery is concerned, it is probable that no sweeping improvement is to be expected, at any rate, in the near future. Canadian thrashing drums can sometimes cope with 2,000 bushels a day, which is a fair indication of the general efficiency that has been reached on the farm, when contrasted with a normal of some 400 bushels in this country; whilst at Montreal, the foremost grain port of the world (beating New York by 40 million bushels in 1923), a new elevator is in course of erection, into which it will be possible to unload two lake boats at once, each at the rate of 30,000 bushels an hour. Machinery capable of such performances would hardly seem to require much improvement.

An advance which is still sometimes advocated is that the Canadian farmer should adopt the harvesting machine, known as the stripper, which is used to such good effect in Australia and the Argentine, where only the heads of the wheat are cut off, and much stooking and lifting is avoided by the same machine thrashing the grain as it goes along. Such a machine, however, is out of the question for use in Canada, though large numbers are made there for export, owing to there being too much humidity in the atmosphere to allow the bagging of the grain until it has been dried to some extent in the field.

In the matter of agricultural machinery, Canada, as a new country, has been the pioneer, and any future improvements in her methods are not likely to be introduced from other countries, but will be evolved within her own borders.

Marketing.—At present practically all the wheat for export finds its way out of the country by means of the Great Lakes and the River St. Lawrence, and this route is closed in winter by ice. With the opening of the already partly constructed railway line to Port Nelson on the shores of Hudson Bay, whereby the route to Liverpool will be shortened by almost 1,000 miles, the congestion will be relieved to some extent, but this route also will be closed by ice in winter. Hence it is not unlikely that considerable competition will result from the development of Vancouver as a grain exporting centre. The completion of the Panama Canal has brought this seaport within reach of the harbours of the Old World, and her waters have the advantage

of being open all the year round. One of the most striking things to be seen at Vancouver is the loading of ships with cargo (though not, of course, with wheat) for direct sailing to Toronto. Already some 30 million bushels of wheat are shipped to Europe from the western port in the course of a year, and great preparations are in hand for increasing this trade.

The eastern harbours are fully alive to this new development, and are launching schemes for the improvement of the St. Lawrence, with a view eventually to making the lake-head ports available for ocean-going traffic, and thus eliminating the transhipment which at present has to take place at Montreal.

All these improvements will be much to the advantage of the prairie farmer, and in addition there are many other factors contributing to the betterment of his position. Among them reference may be made to the recent development of co-operative machinery for marketing farm products, a development which has been ably fostered by the Co-operation and Markets Branches of the Provincial Departments of Agriculture. The Canadian Wool-Growers' Co-operative Association has already been in existence for some three or four years, and the more recent co-operative elevator companies are now doing their part in enabling farmers to dictate the manner in which their grain is to be handled. Schemes for applying the same principles to dairy and other produce are meeting with success, and the one outstanding purpose underlying all these undertakings is to maintain the true spirit of co-operation, and to preclude the man with a mere financial interest from obtaining any hold on the business.

Agricultural Education.—Although the control of agricultural education is largely in the hands of the Provincial Governments, the provinces benefit by liberal grants from the Dominion Government for this purpose. For the last ten years and more about £200,000 a year has been distributed from Ottawa to this end, and we find great colleges and schools up and down the country, whose duty it is to teach the science of agriculture. The oldest of these was founded in Quebec in 1859, and there are now several others, of which that at Guelph, Ontario, including some 700 acres of land, is perhaps the best known.

Although the primary function of the agricultural colleges is to give training in the theory and practice of farming, provision is also made for conducting experimental work, and for publishing the results of such work.

The activities of the various institutions in this direction are supplemented by those of the Extension and Publicity Division of the Dominion Experimental Farms system, which, in addition to the printing and distributing of the records of experiments by pamphlets and through the Press, provides Illustration Stations to the number of nearly a hundred in different parts of the country. These are to be found on the land of representative farmers, who undertake to work according to instructions received from Ottawa, which are based on the results of the work of the experimental farms.

As far as the teaching side is concerned, great stress was at first laid upon the practical work carried out by the students, but opinion has veered round to such a degree that practically no outdoor work is now performed by them at the colleges, which are not regarded as being suitable for this class of instruction. Instead, the students are sent to commercial farms, where they work during the vacations, which are arranged to cover the best part of the year from this point of view. The colleges are in most cases attached to Provincial Universities, so that the college staffs can confine their activities to technical subjects, leaving the University to deal with the fundamental sciences, literature, sociology, and so forth.

A two-years' course at a college leads to a diploma, and a further two years to the degree of Bachelor of the Science of Agriculture (B.S.A.). At the schools a two-years' course is provided. Short courses are held in such subjects as dairying, seed and cattle judging, bee-keeping, fruit-growing, domestic science, etc. No college would be considered complete, which did not possess a cattle-judging arena, where the students sit round on raised benches, whilst cattle are exhibited in the ring by the instructors.

Even the Elementary Schools are well equipped to give an initial impetus to the study of agriculture by means of nature study classes and by school gardening, the teachers attending special courses at the colleges to prepare them for such work.

In addition to the experimental studies performed by the colleges, similar work is also undertaken by the 23 experimental farms and stations scattered throughout the country. These are all branches of the Dominion Experimental Farm at Ottawa, and are supervised from there by the director of experimental farms.

In spite of this generous provision for agricultural education, the scheme has not escaped several adverse criticisms. Sir John Russell has pointed out that agricultural science in Canada is

characteristically direct in its methods, and tends to leave the fundamental problems somewhat in the background. This is no doubt due to the fact that the work is almost all under the control of the Legislature, from whose point of view the direct attack is the most impressive. The defect is partly counterbalanced by the obvious advantages of centralisation, one such advantage being the provision against unnecessary duplication, a fault, which, in the opinion of some experts, is retarding agricultural progress all over the world. For the practical value of some of their experimental work, it would be hard to beat the record of the college at Guelph, in that the increased yields of barley, oats and winter wheat in Ontario, which are directly traceable to the work of that college, amount, at average market prices, to over 30 times as much as the net expenditure of the college since its foundation.

As far as the teaching is concerned, the colleges have been also criticised on the ground that they have failed to train men to be farmers, and thus to maintain a rural population. This is a very sweeping statement, and facts with which to meet it are hard to find, owing to that fluidity of the population to which reference has already been made, but it has been found that 54 per cent. of the past students of the Guelph College are now farming.

In conclusion, in Canada to-day we see a flourishing country, whose people have their eyes wide open to the almost limitless possibilities which lie before them, and whose purpose it is to be ready on all occasions to seize immediately every opportunity which offers of keeping pace with progress throughout the world.

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AGRICULTURAL COSTINGS IN SWITZERLAND AND DENMARK.

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II.—DENMARK.

SIMILAR work has been carried out in Denmark by Dr. Larsen since 1917, and the statistical data collected by him from the carefully kept accounts of more than 400 holdings of varying size have brought out the strong and weak points of the small holding system in a remarkable manner. It is only after carefully studying trustworthy data of this description that one can finally decide how far we, in England, should be justified in following the example of the Danes and adopting a policy

which involves the breaking up of the large estates. If such a policy is adopted, and the tendency certainly points that way, what size of holding is likely to give the best results for the nation as a whole and the individual farmer concerned?

If a time comes when we must, as far as possible, be self-supporting as far as our food supply is concerned, it is undoubtedly the small holding which is wanted. Dr. Larsen's figures answer that point conclusively.

TABLE IV.

Variation of Gross Output with Size of Farm. Average of Results, 1917 to 1923.

Size of Farm.	Gross output in pounds per acre. £ s. d.
Under 25 acres	20 1 0
From 25 to 50 acres	15 4 0
,, 50 ,, 75 ,, ...	15 3 0
,, 75 ,, 100 ,, ...	13 18 0
,, 100 ,, 250 ,, ...	12 8 0
Over 250 acres	12 4 0

Is the time coming when we may lose our industrial supremacy; when the industries in the towns can no longer absorb our surplus population, and the question of employment of labour be one of the planks upon which a national agricultural policy will be built? The figures of Dr. Larsen will show that it is the small holding which, unit for unit, is socially in this respect the best.

TABLE V.

Size of Holding.	Wages paid per acre. £ s. d.	No. of men employed per 100 acres. No.
Under 25 acres	8 12 0	11.3
25 to 50 ,, ...	5 15 0	7.8
50 ,, 75 ,, ...	5 10 0	7.0
75 ,, 100 ,, ...	5 2 0	6.5
100 ,, 250 ,, ...	4 2 0	5.4
Over 250 ,, ...	4 2 0	5.4

The individual farmer, however, will want to look at the matter from the personal point of view; the economic side rather than the social aspect of the matter will appeal to him. He has entered the business of farming as a business man, with him farming is a means to livelihood; he wants to pay high wages for his men; he wants to give employment to as many men as possible, but he must make a living, and it is here on the economic side that the figures of Dr. Larsen are so instructive, for they certainly do not reveal so conclusively the fact that the

small holding of approximately 20 acres, so common in Denmark, is the most economic unit. It is handicapped by high capitalisation, particularly in the form of non-productive capital; by high working costs, by the uneconomic employment of labour, both man and horse, to such an extent as almost, if not quite, to overbalance the social advantages it enjoys.

TABLE VI.
Capital Invested per Acre.

Size of Holdings.	Land.			Buildings.			Working Capital.			Total Capital.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Under 25 acres	16	10	0	18	8	0	20	12	0	55	10	0
25- 50 acres	17	5	0	13	5	0	15	8	0	45	18	0
50- 75 acres	19	3	0	12	4	0	14	15	0	46	2	0
75-100 acres	18	18	0	11	18	0	13	8	0	44	4	0
100-250 acres	18	10	0	9	18	0	11	10	0	39	18	0
Over 250 acres	19	8	0	10	2	0	10	7	0	39	17	0

When once the land has been acquired, buildings must be erected, and working capital found, before that land can be efficiently farmed. A glance at the table above will show that in the case of the small holding under 25 acres the total capital invested in the farm is approximately *three and a half* times the value of the land, and in the case of the holding of 250 acres roughly *twice* the value of the land.

It is unfortunate, too, that on small holdings such a large proportion of the capital is made up of non-productive capital in the form of buildings, implements and other dead stock, which are not likely to be put into circulation.

TABLE VII.
Nature of Capital.

Size of Holdings.	Capital per acre.									Percentage of capital in non-productive or non-liquid form.
	Non-productive.			Productive.			Total.			
	£	s.	d.	£	s.	d.	£	s.	d.	
Under 25 acres	23	2	0	32	8	0	55	10	0	42
25- 50 ,,	15	12	0	30	6	0	45	18	0	34
50- 75 ,,	15	4	0	30	18	0	46	2	0	33
75-100 ,,	14	10	0	29	14	0	44	4	0	33
100-250 ,,	12	0	0	27	18	0	39	18	0	30
Over-250 ,,	12	10	0	27	7	0	39	17	0	31

From the individual economic standpoint it is not so much the gross output that matters as the net; it is not the sales off the farm, its production or productivity that stands out as pre-

eminently important, but the margin between the production costs and prices realised on sale.

TABLE VIII.
Danish Results.

Size of Holdings.	Capital invested per acre.			Output per acre.			Cost of upkeep per acre.			Net balance per acre.			Normal interest on capital invested.			Balance per acre after allowing for normal interest on capital.		
	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Under 25 acres	55	10	0	20	1	0	17	10	0	2	11	0	2	15	0	–0	4	0
25-50 acres	45	18	0	15	4	0	11	16	0	3	8	0	2	5	0	1	3	0
50-75 acres	46	2	0	15	3	0	11	10	0	3	13	0	2	6	0	1	7	0
75-100 acres	44	4	0	13	18	0	10	4	0	3	14	0	2	4	0	1	10	0
100-250 acres	39	18	0	12	8	0	9	5	0	3	3	0	2	0	0	1	3	0
Over 250 acres	39	17	0	12	4	0	9	4	0	3	0	0	2	0	0	1	0	0

In this respect there is, on broad general lines, an almost uniform agreement between the results obtained by Dr. Larsen in Denmark, Dr. Laur in Switzerland, and those which we have obtained from a more detailed study of a smaller number of farms in Yorkshire. In none of these cases is the small holding of 30 acres which is so common on the Continent found to be the most economic unit. After allowing for normal interest on the capital invested in the holding, and charging the labour of the small holder himself, at the normal rate paid to the hired man, there has been during the last seven years, an annual yearly deficit of 4s. per acre on the small holdings under 25 acres. The efficiency of the holding increased with its size up to a maximum which was reached on farms of between 75 and 100 acres, on which a surplus of 30s. per acre was obtained and then fell off steadily as the holding increased, the surplus on farms of over 250 acres being approximately £1 per acre.

The records of Dr. Laur show that if a man be placed on a holding of under 12½ acres, he would be £2 3s. 6d. an acre, or roughly 10s. a week better off were he employed as a hired man on a larger farm and were the money which he has sunk in his holding invested in Corporation or other Trustee Stock.

The records of Dr. Larsen show that if a man be placed on a holding of just under 25 acres, he would be 4s. an acre, £5 a year, or roughly 2s. a week, better off were he to hire himself out on a larger farm and invest his money again in Trustee Stock instead of in his holding. There are undoubtedly many

men so constituted that they would prefer to work for themselves, as their own masters, and order their own lives in their own way, rather than place themselves at the beck and call of another man, even if by so doing they were sacrificing something; and undoubtedly this spirit of independence is a thing to be encouraged and fostered.

A study of Dr. Larsen's figures shows that in Denmark, as in England, the small holder relies almost entirely upon the sales of produce of animal husbandry for his revenue.

TABLE IX.
Disposal of Produce Marketed.

Size of Holdings.	Sales per acre.			Total.
	Plant products.	Products of animal husbandry.	Other sales.	
	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Under 25 acres	0 18 2	15 5 10	1 9 6	17 13 6
25- 50 ,,	1 1 9	10 5 10	0 11 8	11 19 3
50- 75 ,,	1 18 3	9 14 8	0 12 0	12 4 11
75-100 ,,	1 18 5	8 12 10	0 11 1	11 2 4
100-250 ,,	2 0 0	6 15 0	0 9 10	9 4 10
Over 200 ,,	4 8 7	4 14 9	0 12 4	9 15 8

Evidently he manages his grass land *better*, and his arable land, particularly the area under corn, *worse* than his brother on a large holding, as can be seen from the following records extracted from Dr. Larsen's figures.

TABLE X.

	Yield of Grain per Acre. Cwt.	Food Units of Grass and Forage Crops per Acre.
Under 25 acres	16.2	1,080
25 to 50 acres	16.8	965
50 to 75 acres	19.5	978
75 to 100 acres	20.2	840
100 to 250 acres	20.4	836
Over 250 acres	21.0	800

The skill of the small holder in the management of stock, the value of the individual attention which he is able to give to them—points which we have noticed in our own records on the farms which are being costed through the Leeds University Department in Yorkshire—are brought out by a study of Dr. Larsen's figures, as are also the handicaps that the small holder has to suffer in the overstocking of horses and the uneconomical use that can be made of the horse labour on holdings that are too small.

The following extract taken from a report sent off on 12th December, 1924, to L.C.A., a small holder farming 48 acres in the Doncaster area, may in this respect be of interest:—

"In many ways the holding at —— is handicapped in the same way as are the small holdings in Denmark and Switzerland. Possibly one of the most striking cases is the way in which it is heavily overstocked with horses, with the consequence that sufficient work cannot be found for them to keep them really busy on the farm. The following comparison of the efficiency of the horse labour on Mr. ——'s farm and on the 54 farms already referred to is certainly instructive.

TABLE XI.

	L. C. A.	Average of 54 farms.
No. of working horses kept per 100 acres ...	10	2.9
No. of working days per horse per year ...	54	148
No. of working horses kept per 100 acres of arable land...	14.3	5.7
Cost of horse labour per working day ...	10s.	4s. 10d.
Cost of upkeep per horse per year	£26 15s. 11d.	£35 15s. 4d.

In Denmark the really small holding of under 25 acres is nearly four times as heavily stocked with horses as is the large holding (for that country) of over 250 acres. The influence of the individual attention which can be given on the small holding is seen from the fact that on these holdings the food consumption and the total cost of upkeep have been reduced by nearly one-half. The fact that the horses on the small holdings cannot be kept busy is seen when it is realised that on the smallest holdings they worked for 94 days per head per year and on the largest for 212.

The skill in management of these men is shown by the fact that in spite of the small number of days the horses were working, the cost of horse labour was only eightpence per working day more than on the largest holdings which could keep horses busy.

The value of the individual attention that is given to stock by the small holder is seen from a study of Dr. Larsen's records of poultry and pigs (Tables XII and XIII). From these it will be seen that the small holder stocks his land heavily with birds (on the holding of under 25 acres possibly too heavily), watches his feeding remarkably closely, with a saving of 3s. per head, as compared to those on the holdings of over 250 acres, where the birds would be most probably looked after by hired labour; while the largest profits per bird and per pig were made on holdings in the one case just under and in the other just over 50 acres.

TABLE XII.
Poultry.

Size of Holding.	No. of birds kept per 100 acres.	EXPENDITURE PER HEAD. Food.	Labour.	Total.	PROFIT. Per Holding.	Per Acre.	Per Bird.
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Under 25 acres ...	294	0 8 0	0 2 4	0 10 4	9 0 0	1 12 0	0 4 11
25 to 50 acres	132	0 8 10	0 1 8	0 10 6	13 10 0	0 19 8	0 5 6
50 to 75 acres	122	0 9 10	0 1 9	0 11 7	17 0 0	0 14 0	0 4 6
75 to 100 acres... ..	72	0 10 2	0 2 1	0 12 3	13 0 0	0 7 6	0 4 2
100 to 250 acres ...	39	0 10 10	0 1 10	0 12 8	15 10 0	0 4 10	0 4 3
Over 250 acres	30	0 11 0	0 2 3	0 13 3	17 0 6	0 1 6	0 3 10

TABLE XIII.
Pigs.

Size of Holding.	No. of Food Units fed per pig.	PROPORTION OF FOOD FED Meal.	Milk or Whey.	Coarse Fodder.	Labour bill per pig.	Profit per pig.
		per cent.	per cent.	per cent.	£ s. d.	£ s. d.
Under 25 acres	509	62.6	22.5	15.9	0 19 6	0 12 2
25 to 50 acres	542	67.8	21.3	10.9	0 10 4	0 16 3
50 to 75 acres	530	74.8	19.2	6.0	0 8 4	1 8 6
75 to 100 acres	550	71.8	20.7	7.5	0 9 0	1 0 6
100 to 250 acres	574	71.7	20.1	8.2	0 9 10	0 13 2
Over 250 acres	618	75.8	17.8	6.4	0 13 0	0 3 6

IRIS DISEASES.

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THE group of Irises known as Bearded or Flag Irises, especially the section classed as Pogoniris Irises, which includes all the newer garden hybrids, are particularly liable to two forms of disease which, under certain conditions, may cause serious damage. These are "leaf-spot" or "leaf-blotch" and "rhizome rot," the one attacking the foliage and the other the thick, fleshy rootstocks, or rhizomes of the plants. In each case, whenever the attack is severe, complete destruction is effected. In addition to these two diseases a leaf-rust occasionally occurs.

Cultural Note.—Careful observations have led to the conclusion that the conditions under which the plants are grown together with the cultural practice, are factors influencing considerably their susceptibility to attacks by disease. It appears to be appropriate, therefore, to state briefly the methods of cultivation which experience has shown to yield the best results.

Situation.—Formerly it was thought by most people that the Genus Iris was a race of moisture-loving plants. However true that may be of such groups as the Japanese Irises (I. Kæmpfiri) and the English Irises (I. Xiphiodes), it is certainly not so as regards the bearded group.

All members of this group should be planted in a situation where, particularly as regards the latter part of the year, the maximum amount of sunshine is obtained, and where, also, there is least risk of permanent soil wetness or stagnation of any kind inducing acidity or sourness. For preference, the site should be a sloping bank or terrace, where efficient natural drainage is obtained. It cannot be too strongly emphasised that perfect drainage is of paramount importance, and in its absence sound growth and ripening of the rhizomes is impossible.

Soils.—With the possible exception of pure peat, most soils will grow the bearded irises, provided that where lime is naturally absent it is applied freely. Hence it is that ideal soils are found in the chalky loams. Clay loams, too, given good dressings of lime or chalk, will produce equally vigorous plants.

As regards cultivation, the most essential points are to see that the plants are taken up and replanted frequently—at least every three years—and to plant on deeply-worked soil. In planting it is important to keep the rhizomes as near the surface as possible,

so that their upper portions may be exposed to sun and air. Fresh manure should not be used on any account, and the importance of lime must be borne in mind constantly.

Experience shows that the best time to replant irises is immediately after the flowering season, and not, as is commonly believed, in the autumn or early spring. When the plants are to be brought in, or in other circumstances necessitating their partial drying off, it is advisable to defer planting till a month or so later.

Leaf-Spot or Leaf Blotch.—This disease was first noticed in this country in 1893. It usually becomes evident about the time of flowering, and spreads most rapidly during damp weather. In the early stages of attack, faint yellowish-brown spots appear on the leaves which become rapidly darker and more pronounced, so that in a very short time a clearly defined area of dead leaf tissue is distinguishable. These areas, when examined with a hand lens, will be found to bear minute black fruiting threads or conidiophores of a fungus, and on them multitudes of spores are produced, which are easily distributed by the wind and infect fresh leaves.

The disease spreads very rapidly, and the entire leaf blade soon becomes covered with spots which, spreading irregularly, merge into each other, and in consequence the leaf collapses and dies. If this continues unchecked, the whole of the foliage ceases to be of any material use to the plants, and they are as a result weakened considerably, apart from any question of general unsightliness of the attacked foliage.

The fungus is easily recognised by microscopical examination, owing to the characteristic appearance of its spores. They are elongated with rounded ends, and are divided by cross walls into two, three or more cells, each of which is capable on germination of sending out a germ tube which enters the iris leaf usually through a stoma. The surface of the spore is finely echinulate or spiny.

These spores are produced abundantly, especially in the summer and autumn, and are responsible for the spread of the disease. In mild climates they may also be produced during the winter, but only in small numbers. The fungus passes the winter in the form of mycelium or spawn in the old infected leaves, and in spring spores are again produced and distributed.

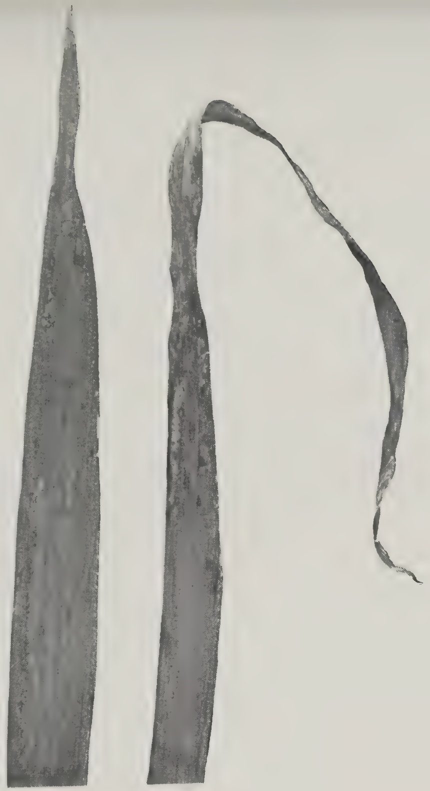
Recent investigations in Wisconsin, U.S.A., have shown that the fungus also produces in spring, on the old dead leaves, a perfect form of fructification. This consists of flask-shaped

structures (*perithecia*) containing sacs (*asci*) in each of which eight spores (*ascospores*) are developed. In some seasons, however, the *perithecia* remain barren, and they therefore cannot be absolutely essential for the continued existence of the fungus.

On account of the development of these *perithecia* it is now possible to name and classify the fungus more certainly. In the conidial or summer spore stage it was long known as *Heterosporium gracile* Sacc. It has now been shown on the grounds of priority and systematic nomenclature that it should in future bear the name *Didymellina iridis* (Desm.) v. Hoh. These changes in nomenclature are apt to be somewhat confusing, but they appear to be inevitable as systematic mycological knowledge evolves. The practical man need scarcely concern himself with them, but specialists will find full details of nomenclature and synonomy of this fungus discussed in papers by J. K. Ramsbottom (*Jour. Roy. Hort. Soc.*, Vol. XL, iii, April, 1915, p. 481) and W. B. Tisdale (*Phytopathology*, Vol. X, 1920, p. 148) respectively.

Control Measures.—This leaf spot or blotch is not a disease that can be got rid of by direct attack. Spraying has been attempted but has not given satisfactory results, doubtless partly because it is almost impossible to wet the glaucous, waxy foliage with a spray-fluid. Two points in particular have to be borne in mind. In the first place those plants are most prone to attack which are in an unhealthy condition owing to unfavourable soil and cultural conditions. Lack of lime is one of the commonest sources of want of vigour, and the application of phosphates has also proved to be beneficial. Superphosphate may be applied evenly and thinly in spring at the rate of from two to three ounces per square yard and worked into the soil. Basic slag, which supplies both lime and phosphate, may also be used similarly and in somewhat larger quantities.

The second point is that the parasitic fungus over-winters in the old affected leaves, and these alone are the means by which the disease is perpetuated. Careful and thorough removal and burning of the affected and dead leaves in the autumn has been proved, in the case of this disease, to be well worth while. At the same time, the ground should be dressed with slaked lime at the rate of about 2 lb. to the square yard. This should be worked in at once and removal of the plants is not necessary. This hygienic treatment of removing the sources of infection, combined with stimulation with lime, will result in the production of clean foliage in the spring, which will remain in this condition through the season.



Photos by]

FIG. 1.—Showing the early stages of Iris Leaf Spot.

[G. Dillistone.

FIG. 2.—Iris Leaf Spot. Appearance of leaves when killed, showing spore-producing areas.

Rhizome Rot.—Particularly in the case of soils deficient in lime iris rhizomes frequently become attacked by a serious disease which takes the form of a soft pulpy rot of a most offensive nature. The first symptoms of its appearance are shown by the yellowing of a crown of leaves and their rapid collapse or by the falling over of a flower spike. Attacked rhizomes rapidly become a soft mass of decay, and unless this can be arrested the plants are destroyed.

This disease has been known for a considerable time and occurs both in Europe and America. It is known that the rot is caused by bacteria, and it seems that under varying conditions somewhat differing types or species are concerned. *Pseudomonas iridis* and *Bacillus omnivorous* are the names of two that have been described and studied in some detail, whilst recently Dr. Paine isolated from diseased rhizome material supplied by the Ministry's Pathological Laboratory an organism belonging, like the second mentioned above, to the *Bacillus carotovorus* group. In all cases the result of attack is that the middle lamella which normally binds the cells of the tissues of the rhizome together, is dissolved, and a pulpy more or less fœtid smelling mass results.

It is known that the disease is favoured by excessive wetness and also by shading, and such conditions should, therefore, be avoided. When the disease has taken a thorough hold of the plants, cure is almost impossible. In such cases they should be dug up and their remains destroyed by fire in order to render the infective material innocuous. The soil should be dressed with quicklime and not used again for planting irises for a time. In cases of slight attack the diseased portions may be carefully cut away and the knife used for so doing kept sterilised by frequent dipping into a suitable disinfectant, such as a solution of lysol. The trimmed rhizomes may then be dipped in a pink solution of permanganate of potash before replanting, the site having meanwhile been dressed with lime.

It is important that healthy plants only should be bought for planting, and upon the slightest sign of the disease being detected it is safest to dig up and destroy the affected plants, care being taken to remove and burn the surrounding soil. The site should then be dressed with fresh lime. Where a plant is only slightly attacked the diseased portion may be cut carefully away, and the healthy portion washed in a pink solution of potassium permanganate before it is replanted.

As in the case of leaf spot it has been found that where an effort is made to promote sound, healthy growth by application of lime and superphosphate the risk of damage by rhizome rot is lessened. The disease is most prevalent in wet seasons.

Rust.—Another disease of irises is the leaf rust caused by the fungus *Puccinia iridis*. This disease does not single out any particular group for attack, and is occasionally found on wild species in this country as well as on the various garden hybrids.

Small reddish or dark brown spots are scattered in more or less profusion over the leaves. They are from $\frac{1}{8}$ in. to $\frac{1}{4}$ in. long and about $\frac{1}{16}$ in. broad. They are usually surrounded by a paler coloured halo of diseased tissue. On the older spots greyish-brown blisters arise in the centre. Rupture of the skin eventually occurs, and a bright brown powdery mass of spores is thus exposed. These are the so-called summer spores, and their distribution results in the spread of infection and consequent development of new spots. Later on in the season a second kind of spore pustule is produced, particularly towards the bases of the leaves. The spores produced here are two-celled and have very thick walls. They serve to carry the fungus over the winter and on germination in spring produce a third form of spore from which infection occurs anew.

Further than the removal and burning of badly affected foliage no remedy is known for this rust, which, as a rule, is not of serious importance in gardens and nurseries. Beyond disfiguring the foliage, not much damage is done, since the plants are not seriously undermined in strength as is often the case with the leaf-spot disease described above.

* * * * * *

THE CUCKOO.

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THE advent of the cuckoo is probably one of the most eagerly anticipated events in Nature's calendar, and one realises with some surprise that, until comparatively recently, little was known of the life history of this most interesting bird.

So far as British ornithology is concerned, the cuckoo is unique, as it is the only species which maintains no nest of its own, but deposits its eggs in the nests of other small birds, leaving with the unfortunate owners the responsibility of rearing its offspring. It is remarkable that small birds should willingly rear the young of a bird twice or thrice their own size, and one can imagine

that the amount of labour entailed is colossal, especially with such a voracious feeder as a young cuckoo.

Economically, the cuckoo is in the main a useful bird, as its food consists chiefly of insects and their larvæ. It is one of the few birds that can comfortably digest such bristly propositions as the larva of the common tiger moth—the " woolly bear " so well known to children. It also eagerly devours the larvæ of the magpie and buff-tip moths, caterpillars that appear to be distasteful to many birds. On the adverse side must be set the fact that it is responsible for the destruction of a number of the young of other insectivorous birds.

The cuckoo usually arrives in this country during the second or third week in April, and leaves us in August or September. In the Home Counties, 15th April is probably the average date of arrival. In the writer's own district (North Kent), the bird has been first seen or heard on that date during the last two years, while in 1922 it arrived on 14th April, and in 1921 on the 16th. This year, however, a specimen appeared on 11th April. There are, of course, records of the bird's arrival during March, but such cases are exceptional. There is a good deal of evidence in support of the theory that the cuckoo is polyandrous, and during the breeding season females are frequently seen accompanied by two or even three males.

The majority of our female cuckoos commence to lay about the second week in May. Records of eggs during the first week in May are not numerous, and in April are extremely rare. The egg discovered by the writer in Essex on 26th April, 1924, is possibly the earliest authentic record of an egg in this country (see *British Birds*, Vol. XVIII, pp. 56 and 57). Other early records are those of Mr. H. S. B. Goldsmith, Somerset, 28th April, 1894 (*Zoologist*, 1894, p. 224), and Mr. A. W. Johnson, Berkshire, 29th April, 1912 (*British Birds*, Vol. VI, p. 18). There are also cases reported on 30th April, from Surrey (Mr. F. C. Selous), and Cheshire (Mr. F. S. Graves).

In our country, the species most frequently used as fosterers are the Meadow Pipit and the Hedge-sparrow, but many other birds are victimised. The full list is a formidable one, and it is sufficient to mention such species as the Redbreast, Tree Pipit, Pied Wagtail, Wren, Blackcap, Garden Warbler, Reed Warbler, Nightingale, Yellow Bunting, Reed Bunting and Whitethroat. There are extraordinary records of cuckoos laying in the nests of such birds as the Ringdove and the Little Grebe, but as Mr. Frank Finn remarks, the birds responsible for these deposits

must have been acting on the principle of "any port in a storm."

The following is a summary of the cuckoos' eggs or young found by the writer during the years 1920 to 1924. Most of the species of fosterers mentioned may be regarded as common ones but cuckoos do not frequently use the nests of Reed Buntings and Chaffinches' nests but rarely.

	Hedge-sparrow	Meadow Pipit	Pied Wagtail	Redbreast	Chaffinch	Garden Warbler	White-throat	Reed Bunting	Tota
1920	3	1	1	—	—	—	—	—	5
1921	4	3	1	1	—	—	—	—	9
1922	3	2	—	—	—	—	—	1	6
1923	4	1	1	—	—	1	1	—	8
1924	5	4	—	1	1	—	—	—	11
									39

The two eggs shown as having been found in 1923 in the nest of the Garden Warbler and Whitethroat are of particular interest as they were found in nests situated within a hundred yards o each other, were identical in colour and marking, and were un doubtedly laid by the same cuckoo.

For many years ornithologists have been divided in opinion a to the method adopted by the cuckoo when depositing its egg i the nest of a fosterer. One side had it that the bird always lai its egg direct, *i.e.*, while sitting on the nest. The other contende that the egg was first laid upon the ground, and afterward removed in the bird's bill to the selected nest. After years c patient study, Mr. Edgar Chance has established that in the cas of nests of the open type, such as that of the Meadow Pipit, th former method is adopted, and that his discoveries in such case leave no doubt, will be admitted by all who have seen his remark able cinematograph records. It appears equally certain, howeve that in some instances the cuckoo is compelled by force of circum stances to employ its bill. The writer has known several cases i which it would appear to have been impossible for the bird to hav introduced its egg in any other way. There is, for example, case in Essex where a young cuckoo was found in the nest of pied wagtail. The nest was built in a hole in a brick wall. Th cavity in which the nest was situated was fairly roomy, but th entrance was considerably less than two inches in diameter, an was about three inches in length. The surrounding brickwor had to be chipped away before the young cuckoo could b liberated. It is difficult to imagine how an adult cuckoo coul have entered this hole for the purpose of laying an egg, and it reasonable to assume that the bird, after laying the egg els

Fig. 1.—The Cuckoo.

FIG. 2.—The Cuckoo's egg, together with eggs of foster birds

1. Cuckoo.
2. Goldcrest.
3. Meadow Pipit.
4. Reed Bunting.
5. Whitethroat.
6. Robin.
7. Hedge-sparrow.
4. Wren.
9. Nightingale.
10. Yellow Bunting
11. Reed Warbler.

here, inserted it with its bill. There is a somewhat similar case ecorded from Berkshire, where a pied wagtail's nest, built in a arrow-necked pickle jar, was found to harbour a young cuckoo.

Mention may be made of another interesting case from the riter's own experience. In 1912, in South Essex, a redbreast's est, built in an old stump, was found to contain two redbreast's ggs and one of the cuckoo. The stump was fourteen inches in eight. The entrance hole was $1\frac{3}{8}$ in. diameter and about in. from the top, which had been filled in. The nest was uilt on the ground inside the stump, roughly about 5 in. elow the entrance hole. In this case the difficulties of direct ying would appear to be insuperable. Even if the cuckoo ad deposited the egg in the nest with its bill, it probably had to e dropped an inch or two, and it is doubtful if any of the foster arent's eggs could have been removed.

The egg of the cuckoo is very small compared with the size of e bird, being very little larger than that of a house-sparrow. here appear to be two main types of cuckoos' eggs—one having greenish-white ground spotted with dark ash, and the other aving a buff ground, spotted with brown. There are, however, number of intermediate varieties. The period of incubation is velve days, or occasionally thirteen.

Usually, only one egg is placed in each nest, and the total umber of eggs laid by one bird in a season is still uncertain; stimates vary from a dozen to twenty-five. Before depositing its gg, the bird generally removes one or more of the eggs of the ghtful owners, and there is no doubt that eggs so removed are metimes eaten by the cuckoo. At the same time, it must be entioned that there are records of cuckoos laying in empty ests. The egg already referred to as being discovered by the riter on 26th April, 1924, was laid in an unfinished nest of the dge-sparrow. On 17th May, this nest contained two young edge-sparrows and one hedge-sparrow's addled egg. Other milar records are those of Mr. E. L. Wood, Harrow—cuckoo's gg in unfinished nest of the Goldcrest (*Zoologist*, Vol. XX, 275); and Mr. Pearce—one in an unfinished nest of the Reed arbler (*Countryside*, 19th May, 1906). In the latter case, e warblers continued building after the cuckoo's egg had been posited. On 17th June of this year, the writer, for the first me in his experience, found two cuckoos' eggs in the same nest hedge-sparrow's). These eggs were of entirely different types, d were obviously laid by different cuckoos.

The idea that the cuckoo lays its eggs with the object of matching in colour those of the fosterer is erroneous. The writer has seen some hundreds of cuckoos' eggs, *in situ* and in collections, but has rarely seen one that—quite apart from the question of size—could not readily be detected from the remainder of the clutch. It may be admitted that cuckoos using, say Pied Wagtails' nests will lay eggs conforming to a certain type or number of types, and that cuckoos using the nests of Meadow Pipits will lay eggs of quite different types, but this is no indication that such eggs are designed to imitate the eggs of the particular fosterer concerned. As already stated, it is usually not at all difficult to detect the cuckoo's egg in any clutch, and it is highly improbable that the bird has the power to vary the pattern of any of its eggs. Indeed, a series of eggs laid by any one cuckoo will be found to be identical in colour and marking.

The young cuckoo is a greedy and pugnacious little bird, and its habit of ejecting the eggs or young of the rightful owners is fairly well known. The actual process of ejection is very interesting to watch, and the young cuckoo appears to possess an almost inexhaustible store of energy, never ceasing in its efforts until the other occupants of the nest have been thrown out. Physically, it is well equipped for the purpose. If a very young cuckoo be examined, it will be noticed that it has a peculiarly hollowed back. The purpose of this hollow will be apparent when it is mentioned that the cuckoo, when ejecting another nestling, wriggles its way under the latter, and balancing itself with wings and legs, hoists its burden to the edge of the nest and ultimately over it. The writer once experimented in this direction. An ejected nestling was put back into the nest and again thrown out. The process was repeated five times during the day, after which the experimenter's patience proved inferior to that of the young cuckoo. The purpose behind this fury for ejection is not far to seek. With a bird of the size and appetite of a young cuckoo there would be literally no room for competition.

It is particularly noteworthy that a female cuckoo reared, let us say, in a hedge-sparrow's nest, will, when it comes to maturity, use hedge-sparrows' nests for the reception of its own eggs, and that unless the supply of the requisite fosterers' nests runs short, it will rarely use the nest of another species. Equally remarkable is the fact that a cuckoo will return year after year to the same locality, although this characteristic is shared by many other birds. It will be of interest to mention that a hen

cuckoo ringed by the writer as a nestling on Dartford Heath in 1922 returned to the same "pitch" in 1923, and again in 1924. This year, however, it has not put in an appearance. This particular bird used the nests of hedge-sparrows. In 1924 it had a certain amount of competition from another hen, probably one of its own progeny, but the latter was eventually driven away.

Although many points in connection with the life history of the cuckoo have been cleared up in recent years, there is still much to be done. Few birds are more interesting than this, which in many respects may still be termed the "bird of mystery."

* * * * * *

AUGUST ON THE FARM.

J. R. BOND, M.B.E., M.Sc., N.D.A. (Hons.),
Agricultural Organiser for Derbyshire.

Corn Harvest.—Owing to the hot, dry weather of June and July, corn crops this year began to ripen earlier than usual; some, the spring cereals on light land, or where sown late on heavier soils, may have ripened prematurely. According to present indications, harvest should be in full progress by the time these notes appear, provided that weather conditions are favourable. After such a summer, however, it would be unwarrantable optimism to expect long, dry periods in August, which has a high average rainfall and a reputation for making up any deficiency in the amount of rain received during the preceding two months.

The different stages through which corn passes in the ripening process were discussed in these notes last August, and, in particular, it was pointed out that with two exceptions the best stage for cutting is immediately the last tinge of green has gone out of the neck of the straw. The two exceptions were malting barley and autumn seed corn, which, in order to ensure even germination of the sample, should be allowed to reach the dead-ripe stage. Where there is delay in starting the corn harvest, there is usually difficulty in reaping the last fields in proper order; but rarely does one hear of regrets at commencing too soon.

In the days of hand reaping, each scythesman was followed by one woman to gather the grain and one man to bind the sheaves. The three could cut and tie about 1½ acres of wheat or 2 acres of spring corn in the day. Generally the raking up was

done by a boy, one to each two scythes. To make progress at the rate of 8 acres a day, a gang of about 15 workers was required. Corn was necessarily valuable and labour both cheap and plentiful in those times. The mechanical reaper began to be made use of about 1850, and although it left the grain in swathes it enabled one man operating the machine to perform the work of about six scythesmen; and, by liberating them for the duty of binding, it greatly accelerated the harvesting process. By the addition of sheafing attachments to the reaper, the women who previously gathered the grain were displaced, so that the hand labour required in the cornfield was reduced to half of the numbers employed in reaping with the scythe. The self-binder, introduced in 1879, enables one man to cut and tie 6 to 10 acres a day, more or less according to the condition of the crop and the soil and the haulage power available. It is perhaps when soil and crop conditions prevent the use of the binder that the modern farmer most fully realises his dependence on it, and the modern demand for stiff-strawed varieties of corn is one of the results of that dependence.

The side delivery reaper still has its uses. In humid districts, where it is desirable to leave the sheaves on the ground untied for a few days, this machine is popular. By dropping the sheaves out of the way of the team, cutting can proceed without the assistance of anyone to move the cut grain. Some farmers in such localities, however, make use of the self-binder, setting the binding attachment to tie comparatively small and loose sheaves. The reaper has the further advantages of lighter draught, suitability for uneven land and smaller initial cost. It has its adherents in the southern counties of England; but probably its most numerous users are found in France, where cheaper labour is available for tying and where the machine is also applied to the cutting of tall rye and tangled crops, such as lucerne, peas and buckwheat.

In good weather and with crops not containing much green bottom growth, it is hardly necessary to delay stooking; and even where it is considered necessary to allow the sheaves to lie on the ground for a time to expose the butts, the desired result may be obtained without the heads coming in contact with the soil; the sheaves can be arranged in fours to form a square, each sheaf having its heads lying on the butt end of the sheaf adjoining.

Catch Cropping.—The practice of growing catch crops is of most interest to the sheep farmer, and to him especially after his hay crops have mown light and when his prospects of roots

are not good. Also in districts where town dung was formerly depended upon for the maintenance of the humus content of the soil, catch cropping for the purpose of green manuring is attracting attention. Land available in August may be sown with white mustard, rape or hardy green turnips to produce autumn keep, or with rye, Italian rye-grass or thousand-headed kale for spring feed. Mustard and rye are probably the best where the object is green manure. Details respecting the seeding of each of these crops are given in the Ministry's Leaflet No. 392.

For the production of autumn feed or green manure, early sowing is of the greatest importance, as is illustrated by the saying that "a day in July is worth a week in August, and a week in August is worth a month in September." However, the condition of the land or the treatment given modify this. Unless the soil is in high condition, as after bare fallow or liberally manured early potatoes, the catch crop should receive a complete dressing of artificials at the time of sowing. It is well known that catch crops conserve nitrates that might otherwise be washed out of the soil in the winter drainage; nevertheless they themselves are greatly stimulated by soluble nitrogenous fertilisers.

Ordinary stubble catch-cropping is practicable only in favoured districts or exceptional seasons. In the southern counties and the districts warmed in winter by the Gulf Stream, hardy green turnips continue their growth through the winter, the mean daily temperature being above 40 deg. F.; whereas further inland and in the eastern counties the mid-winter temperature is normally below the above-mentioned figure and little growth takes place until about the end of February. Here, however, rye and rye-grass may sometimes be sown with considerable advantage on land that is intended for turnips, cabbage or marrow-stem kale in the following season. Suitably manured and seeded thickly in August or September, and top-dressed with nitrates in March, valuable grazing may be obtained in April or a good cut later in the month, both of which may be invaluable where the supply of roots is short. I have known this practice adopted with advantage on dairy farms in upland country; but admittedly it would be better in some respects to sow about 14 lb. of Italian rye-grass in the preceding spring under cover of the last corn crop.

Pasture Improvement.—Last September I gave details of the renovation of a tough, matted old pasture by ploughing up,

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liming, etc., and seeding down again without cleaning the land or putting it through a rotation of crops. The success of the method depends on the power of wild white clover to suppress undesirable herbage, when conditions are made favourable to the growth of the clover by the application of lime and phosphates. An important aid in this direction, however, is the closeness with which stock graze young pastures laid down with modern simple mixtures. This fact is emphasised by the results of botanical examinations of the herbage of plots laid down by the Agricultural Department of Bangor University College at various centres in North Wales. Incidentally the difference in the persistence of wild and ordinary white clovers is strikingly demonstrated by the Bangor figures.* Doubtless the ploughing up method will be still more successful if the expectations regarding indigenous grasses are fulfilled.

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MONTHLY NOTES ON FEEDING STUFFS.

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Apple Pomace, its Composition, Digestibility and its Use in Practice.—*Origin.*—In the manufacture of cider, the cider apples, after removal of unsound apples, loose stones, dirt, etc., are pulped and filled into press cloths. These filled cloths are then placed in the cider press, and by means of heavy pressure the juice is extracted and pumped into the cider vats. The apple residue is known as apple pomace, a material that forms a useful by-product for feeding to stock. Where conditions are favourable, this product is fed in the wet condition, but under factory conditions it has been found desirable to dry the apple pomace —firstly in order to reduce transport costs, and secondly, to stop fermentation of the wet material. The method adopted in drying is to pass the wet pomace through a heated rotating cylinder,

* See this *Journal*, April, 1925, p. 13, "Improvement of Very Poor Pastures by Ploughing and Immediate Re-seeding."

the resultant dried pomace forming quite an attractive looking and pleasant smelling brown material. Apple pomace, like brewers' grains and sugar beet pulp, is therefore available to the farmer in two forms, as wet pomace and as dry pomace.

Composition of Dried Pomace.—Dried pomace, from an English source, is brownish in colour, and is sweetly acid in taste. An analysis showed the following composition. Moisture 8.3 per cent., fat 4.2 per cent., protein 7.1 per cent., fibre 16.3 per cent., carbohydrates 61.1 per cent. (containing 16.7 per cent. sugar), ash 3 per cent. Dried pomace is essentially a carbohydrate feeding stuff, and contains nearly 17 per cent. of free sugar. The ether extract contains waxes, gums and colouring matter in addition to true fat. In the sample analysed, there was present 2.7 per cent. true fat. About one-third of the nitrogen present is in the non-protein form. Dried pomace is deficient in lime, but contains a fair amount of phosphoric acid and potash, 100 lb. of dried pomace containing 0.26 lb. P_2O_5, and 0.51 lb. K_2O.

Digestibility.—*Approximate Value for purchase.*—The crude protein is 40 per cent., the crude fat is 67 per cent., the crude fibre 5 per cent., and the carbohydrates 70 per cent. digestible. Calculated on the above composition, the table of crude and digestible nutriments would be :—

	Crude Nutrients.					Digestible Nutrients.						
y ter	Crude Protein	Crude Fat	N. Free Ext.	Fibre	Protein	Crude Protein	Pure Protein	Dig. N. Free Ext.	Dig. Fibre	Dig. Fat	N. Ratio	S.E.
.7	7.1	4.2	61.1	16.3	3.0	2.8	1.9	43.8	0.8	2.8	1.18	40.2

On the starch equivalent basis, with maize at 2s. a unit, dried pomace would be worth £4 a ton without allowing for the manurial value. With N. at 12s. 8d., P_2O at 4s., and K_2O. at 2s. 4d. a unit, the manurial value per ton of pomace would be 8s. 7d. Dried pomace would therefore be a reasonable purchase at £4 10s. a ton, with maize at 2s. a S.E. unit. With maize at 2s. 6d. a unit S.E., dried pomace would be a reasonable purchase at £5 10s. a ton.

Use of Wet Pomace.—Wet apple pomace is chiefly used in the west country. It appears to be used for all stock except pigs. In cider-making districts the common practice is to grind down enough apples to make a cider cheese, and immediately

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.
Wheat, British	—	—	12 13	0 14	11 19	71·6	3/4	1·78
Barley, British Feeding	—	—	10 0	0 11	9 9	71	2/8	1·43
" Canadian :—								
No. 3 Western	39/0	400	10 18	0 11	10 7	71	2/11	1·56
" " No. 4 "	38/3	"	10 15	0 11	10 4	71	2/10	1·52
" American	39/0	"	10 18	0 11	10 7	71	2/11	1·56
" Karachi	37/9	"	10 12	0 11	10 1	71	2/10	1·52
Oats, English, White	—	—	11 7	0 12	10 15	59·5	3/7	1·92
" " Black and Grey	—	—	10 10†	0 12	9 18	59·5	3/4	1·78
" Canadian :—								
No. 2 Western	33/3	320	11 13	0 12	11 1	59·5	3/9	2·01
" " No. 3 "	31/9	"	11 2	0 12	10 10	59·5	3/6	1·87
" " Feed	27/3	"	9 10	0 12	8 18	59·5	3/0	1·61
Argentine	27/9	"	9 15	0 12	9 3	59·5	3/1	1·65
Chilian	28/0	"	9 17	0 12	9 5	59·5	3/1	1·65
Maize, Argentine	43/9	480	10 3	0 12	9 11	81	2/4	1·25
Beans, English Winter	—	—	12 0*	1 9	10 11	67	3/2	1·70
" Chinese "	—	—	11 10	1 9	10 1	67	3/0	1·61
Peas, Japanese	—	—	24 15†	1 5	23 10	69	6/10	3·16
Dari, Egyptian	—	—	11 10	0 14	10 16	75·2	2/10	1·52
" Persian	—	—	12 5	0 14	12 1	75·2	3/2	1·70
Millers' Offals :—								
Bran, British	—	—	6 12	1 4	5 8	45	2/5	1·29
" Broad	—	—	8 5	1 4	7 1	45	3/2	1·70
Middlings—								
Fine Imported	—	—	9 2	1 0	8 2	72	2/3	1·20
Coarse, British	—	—	7 17	1 0	6 17	64	2/2	1·16
Pollards, Imported	—	—	7 0	1 4	5 16	60	1/11	1·03
Meal, Barley	—	—	12 0	0 11	11 9	71	3/3	1·74
" Maize	—	—	11 10	0 12	10 18	81	2/8	1·43
" " South African	—	—	9 10	0 12	8 18	81	2/2	1·16
" " Germ	—	—	9 0	0 17	8 3	85·3	1/11	1·03
" " Gluten Feed	—	—	10 0	1 5	8 15	75·6	2/4	1·25
" Locust Bean	—	—	9 15	0 8	9 7	71·4	2/6	1·34
" Bean	—	—	13 0	1 9	11 11	67	3/1	1·65
" Fish	—	—	19 10	3 17	15 13	53	5/11	3·17
Linseed	—	—	21 7	1 8	19 19	119	3/4	1·78
" Cake, English 12°/₀ Oil	—	—	14 0	1 15	12 5	74	3/4	1·78
" " 10°/₀ Oil	—	—	13 5	1 15	11 10	74	3/1	1·65
" " 9°/₀ Oil	—	—	12 17	1 15	11 2	74	3/0	1·61
Soya Bean " 6 % Oil	—	—	12 5	2 8	9 17	69	2/10	1·52
Cottonseed Cake, English 5½°/₀ Oil	—	—	8 0	1 12	6 8	42	3/1	1·65
" " Egyptian 5½°/₀ Oil	—	—	7 15	1 12	6 3	42	2/11	1·56
Decorticated Cotton Seed Cake 7% Oil	—	—	12 17*	2 9	10 8	71	2/11	1·56
" " Meal 7% Oil	—	—	12 12*	2 9	10 3	74	2/9	1·47
Ground Nut Cake 7% Oil	—	—	10 10*	1 13	8 17	56·8	3/1	1·65
Palm Kernel Cake 6°/₀ Oil	—	—	8 10†	1 1	7 9	75	2/0	1·07
" " Meal 2°/₀ Oil	—	—	7 10	1 2	6 8	71·3	1/10	1·98
Feeding Treacle	—	—	7 2	0 8	6 14	51	2/8	1·43
Brewers' Grains :—								
Dried Ale	—	—	8 2	1 2	7 0	49	2/10	1·52
" Porter	—	—	7 12	1 2	6 10	49	2/8	1·43
Wet Ale	—	—	0 17	0 8	0 9	15	–/7	0·31
" Porter	—	—	0 13	0 8	0 5	15	–/4	0·19
Malt Culms	—	—	8 0†	1 11	6 9	43	3/0	1·61

† At Liverpool. * At Bristol.

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at June and are, as a rule, considerably lower than the prices at local country markets, the difference being due and dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at market by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at Its manurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure starch equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. D again by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. calculation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted market. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 11 3s. 7d.; K_2O, 2s. 9d.

after the pressing is over, usually the second day after grinding, the cheese is hauled out into the fields for the cattle to pick it up at will. Occasionally wheat straw is used to bind the pomace in the pressing. Where the cattle are housed the pomace is crumbled and mixed with chaff and meals. The practice of one dairy farmer is to feed it to his milk cows to the extent of 20 lb. per head per day. Another farmer uses it for all stock, but principally milk cows and young cattle. The adult stock receive 12 lb. a head per day. In the autumn, the cows in milk generally get 10-12 lb. of pomace in the morning and 3 lb. of ground nut cake in the evening. From the beginning of December, rather less pomace is used, mixed with chaff and pulled swedes or mangolds; sharps, crushed oats and barley meal being given in addition. The fattening cattle also receive in addition 4 lb. of ground nut cake daily.

Method of Preservation.—In order to prevent fermentation it is usual to tread the pomace into large casks or tubs, water being added during the process, the object being to exclude the air. In this condition pomace will keep fresh for weeks. In one case, the farmer tried treading the pomace into a pit 14 ft. square dug 1 spit deep, watering as before, and covering with 4 in. of soil to exclude the air. In this way 18 tons of pomace were successfully preserved and eventually fed to stock, there being, however, an estimated wastage of 10 per cent.

Methods of Feeding Dried Pomace to Stock.—Dried pomace has been fed successfully in this country to cattle and sheep, both young and fattening and breeding stock, while American experience has shown that dried pomace can be used successfully for milking cows, the cows keeping in good flesh and milking well.

Use with Lambs and Sheep.—For fattening lambs on roots or kale, 1 lb. of pomace can be fed daily mixed with a little ground nut cake, the use of hay being dispensed with. For breeding ewes, when on grass, $\frac{1}{2}$ lb. of pomace a day is sufficient to keep them in condition, but when grass and food are scarce, an *ad lib.* ration of pomace can be given. Both the lambs and ewes keep in excellent condition when pomace is fed, and experience has shown that no ill effects follow when the use of hay is dispensed with.

Use with Cattle.—In the case of cattle it is advisable to begin feeding pomace to calves at six months old, feeding not more

than ½ lb. of pomace per head per day at the start, gradually increasing the quantity until as bullocks they are getting 5 lb. a day. It is usually fed mixed with roots, and when roots are plentiful it is possible to feed more than 5 lb. a day. In Herefordshire, breeding cattle lying out are given up to 6 lb. a day, with straw in addition under severe climatic conditions.

Milch Cows.—American experience has shown that dried pomace can be successfully used. From a feeding standpoint it approximates in feeding value to that of dried beet slices. Milch cows fed on dried pomace continued in good flesh and milked well. It is best fed mixed with other concentrates, and up to 5 lb. per day can be given.

Necessity of Care in Feeding.—Both in the case of sheep and cattle care must be taken to feed the pomace dry, since it has been found that the stock will not touch the pomace if it has been allowed to become wet through rain. In wet weather, therefore, only sufficient pomace should be given as can be eaten immediately, or protection from the rain must be arranged for the feeding troughs.

FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·25	2 4	71·6	8 7	0 14	9 1
Oats	1·25	2 4	59·5	6 19	0 12	7 11
Barley	1·25	2 4	71·0	8 6	0 11	8 17
Potatoes	1·25	2 4	18·0	2 2	0 3	2 5
Swedes	1·25	2 4	7·0	0 16	0 2	0 18
Mangolds	1·25	2 4	6·0	0 14	0 2	0 16
Beans	1·25	2 4	67·0	7 16	1 9	9 5
Good Meadow Hay	1·52	2 10	31·0	4 8	0 13	5 1
Good Oat Straw	1·52	2 10	17·0	2 8	0 7	2 15
Good Clover Hay	1·52	2 10	32·0	4 11	0 19	5 10
Vetch and Oat Silage	1·39	2 7	14·0	1 16	0 7	2 3
Barley Straw	1·52	2 10	19·5	2 15	0 6	3 1
Wheat Straw	1·52	2 10	11·0	1 11	0 4	1 15
Bean Straw	1·52	2 10	19·0	2 14	0 9	3 3

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PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending July 15th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13. 2	13 .0	12.10	12.15	16. 5
,, ,, Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12. 5*	12. 5*	12. 5*	12. 5*	(N)11. 7
Kainit (Pot. 20 per cent.)	3. 2	3. 0	...	...	...
,, (Pot. 14 per cent.)	2.17	2.15	2. 5	...	...
Potash Salts (Pot. 30 per cent.)	...	...	2.10	...	...
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7.10	7. 2	...	...
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	11. 5	...	...
Basic Slag (T.P. 30 per cent.)	3. 3§	...	..	2.15§	1.10
,, ,, (T.P. 28 per cent.)	2.10§	2. 5§	...	2.10§	1. 9
,, ,, (T.P. 26 per cent.)	2. 6§	2. 1§	...	2. 5§	1. 9
,, ,, (T.P. 24 per cent.)	...	1.17§	1.18§	..	...
Superphosphate (S.P. 35 per cent.) ...	...	...	3.15	3. 8	1.11
.. (S.P. 30 per cent.) ...	...	3. 2	3. 8	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	8.15	8. 5	7.17	7.17	...
Steamed Bone Flour (N. ¾, T.P. 60-65 per cent.)	6. 2†	6.10†	6. 5	5.10†	...
Fish Guano (N. 7½-8½. T.P. 16-20 per cent.)	...	...	13. 0	...	...
,, ,, (N. 9, T.P. 10 per cent.) ..	...	...	...	12. 5	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station. London prices are for 4-ton lots.

§ Prices include cost of carriage from works to town named, and at Bristol and London are for not less than 4-ton lots. Hull prices include delivery to any station in Yorkshire, and Liverpool to any station in Lancashire; London prices include delivery within a limited area. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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MISCELLANEOUS NOTES.

Bee Convention at Sparsholt Farm Institute.

A MOST successful gathering of bee-keepers was held on 20th June under the auspices of the Wilts, Hants and Dorset Bee-keepers' Council at the Farm Institute, Sparsholt, Winchester, by invitation of the Hampshire County Council. Some 250 bee-keepers from the neighbouring counties attended.

Mr. C. J. Gleed, Horticultural Instructor for Hants, gave an address on the subject of "Bees in Relation to Fruit Pollination." He stated that there was evidence that under normal conditions "sets" of fruit were much heavier where domestic

bees were kept in close proximity to fruit orchards, while "running-off" in black currants was less pronounced if bees, and particularly hive bees, were able to visit for the purposes of pollination and the extraction of nectar. Mention was made of the damage caused to bees through injudicious spraying with arsenate of lead during the spring.

After lunch, the party made a tour of the apiary which is maintained at the Institute by the Hampshire County Council. Mr. H. P. Young, Instructor in Bee-keeping for Hants and the officer in charge of the apiary, explained the working of the apiary and the part it had played in raising stocks and nuclei and distributing them to bee-keepers in the county. He demonstrated various types of hives in which the bees were seen to be working and explained in detail the advantages and disadvantages he had found in each. He also gave particulars of the experiments with new appliances which are being conducted in the apiary.

Subsequently Mr. Herrod-Hempsall, Technical Adviser in Bee-keeping to the Ministry, gave a lecture on "Advanced Bee-keeping," in the course of which he dealt with methods of manipulation, honey production, strains and races of bees, and other matters of interest and importance.

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Farmyard Manure made under Cover and in the Open.

THE following note has been received from Dr. J. Augustus Voelcker, Consulting Chemist to the Royal Agricultural Society:—

As showing the value of making and keeping farmyard manure under cover as against allowing it to be in the open, exposed to rain, etc., the following comparison obtained at the Woburn Experimental Farm may be found useful.

During the winter of 1922 cattle were regularly fed, on cake, roots, hay, etc., in a yard which is about three-parts covered, the remainder being exposed. The manure—plentiful litter being supplied—was allowed to accumulate, and then carted out in June, 1923, for potatoes, roots, etc. In the spring of 1924 samples of part of the manure which had not been carted out for use in the previous summer were taken from different parts of the yard, and analyses of average samples of these gave the following results:—

	Nitrogen. Per cent.	*Moisture. Per cent.*
From uncovered part	0.505	78.75
From covered part	0.913	71.52

The figures show in a marked degree the advantages of making and storing under cover.

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Extension of Small Holdings in Denmark.

A DANISH law, dated 29th March, 1924, provides for assistance to agriculturists who desire to purchase small holdings. Persons eligible for such assistance comprise agriculturists, horticulturists, agricultural labourers who have worked as such for the last five years, and allied workmen such as brick-makers, fishermen, etc. Approved applicants must first secure an offer of suitable land, or, if they cannot do so, may obtain the help of the communal council in finding land. The minimum area is 5 acres, but there is no maximum.

A local commission appointed for the purpose may then make a loan from State funds for the purchase of the land up to nine-tenths of its mortgage value. Taking the mortgage value, as is usual in this country, at two-thirds of the value of the land the loan would therefore amount to three-fifths of the whole. An additional loan is made for the erection of buildings, both loans bearing interest at $4\frac{1}{2}$ per cent. For the first five years no repayment of principal is required and thereafter both loans are to be paid off by instalments over a long term of years.

The holding cannot be split up or combined with other land without the special consent of the Ministry of Agriculture, and it may only be transferred by the small holder to another, except a son, daughter, etc., if the new owner can also fulfil the conditions for approved applicants.

Provision is also made for loans for the extension of existing holdings, farm buildings, etc.

It will be observed that the provisions of the law are similar to those of Section 19 of the Small Holdings and Allotments Act, 1908, in force in this country, except that here a loan is only available for an applicant who is already the tenant of a holding and wishes to buy it.

Young Farmers' Clubs.

IT has already been stated in this *Journal* (April, 1925, p. 2) that the supervision of the Young Farmers' Club movement, which was initiated in this country under the auspices of the *Daily Mail*, has now been undertaken by the Ministry. The Ministry hopes that, in course of time, a practical interest in the formation and guidance of these clubs will become a recognised part of the agricultural education schemes of Local Education Authorities.

Club work is open to boys and girls of the age of ten years and upwards. Its main purpose is to stimulate in them a love for rural pursuits. Incidentally, it should give them a little acquaintance with the business side of agriculture and horticulture, and so provide a foundation for the more practical study of those subjects which they may, if they so desire, take up in future years. Again, in so far as the boys and girls may be the children of agriculturists, the formation of clubs often affords a means by which members of County agricultural staffs may secure the interest of the parents; such, at any rate, is the experience of Agricultural Organisers (County Agents) in the United States, where the movement has been taken up with enthusiasm.

The Ministry recognises that the initiation of a club must largely rest with some local resident, who is attracted by the project and is able to devote to it some time and energy, but trusts that Agricultural Organisers and other members of County Agricultural staffs will be able, as far as the limited time at their disposal allows, to help in this work and to assist the members of clubs with advice and lectures from time to time.

The Ministry feels that the Clubs should be autonomous, and should look to private sources for any initial help that may be required for the provision of stock, seeds, etc. Experience seems to show that there is little difficulty in obtaining from such sources the small loans necessary.

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Young Farmers' Clubs: International Cattle-Judging Contest.

THE fourth annual International Cattle-Judging contest, between teams representing the Young Farmers' Clubs of the United States of America and England for the *Daily Mail* Gold Challenge Cup, took place on Friday, 17th July. The competition was of special interest, having been the first of its kind organised by the Ministry, which has this year officially taken over the organisation of the Young Farmers' Club movement. Mr. James Mackintosh (National Institute for Research in Dairying) was responsible for the admirable arrangements made in connection with the selection of the dairy stock to be judged. First a ring of four shorthorns was judged at the Reading University Farm at Shinfield. The competitors next drove to Heron Farm at Pangbourne to judge a similar ring of Jersy cattle chosen from Dr. Watney's fine herd. The third ring was judged at Compton Farm, a selection being made of four Friesians from Mr. Barclay's stock.

Through the kindness of Mr. Barclay, luncheon and tea was provided in a marquee at Compton and the teams and visitors had an opportunity of inspecting the up-to-date premises there.

The judging was carried out by Mr. McCandlish, the Dairy Expert of the Glasgow and West of Scotland College of Agriculture, and Mr. Rushton, Principal of the Staffordshire Farm Institute. Mr. Weir, of the Canadian National Railway, acted as Umpire.

The teams were as follows:—

U.S.A.	Harlan Leonard Raymond Monahan Lester Olsen	Franklin County Dairy Calf Club, Iowa (Winners of the American Junior National Championship).
England	Dorothy Dean Ronald Knight	Northease Jersey Calf Club, Lewes, Sussex.
	Leslie White	Hemyock Calf Club, Devon.

The result in points out of 900 was as follows:—

America, 783. England, 755.

The order of merit was:—

Raymond Monahan (U.S.A.), 284 points.
Leslie White (England), 267 points.
Dorothy Dean (England), 265 points.
Harlan Leonard ((U.S.A.), 252 points.
Lester Olsen (U.S.A.), 247 points.
Ronald Knight (England), 223 points.

Farm Workers' Minimum Wages.

A MEETING of the Agricultural Wages Board was held on the 14th and 15th July, at 7, Whitehall Place, S.W.1, the Chairman, Lord Kenyon, presiding.

The Board considered notifications from Agricultural Wages Committees of resolutions fixing minimum and overtime rates of wages, and proceeded to make the following Orders carrying out the Committees' decisions.

Cambridgeshire and Isle of Ely.—An Order to operate as from the 20th July, fixing special rates of wages for employment on this year's corn harvest, the rate in the case of male workers aged 21 and over being 60s. per wk. of 64 hr. (excluding Sunday).

Dorset.—An Order continuing the current minimum and overtime rates of wages for male workers and the minimum rates for female workers until the 27th Feb., 1926, and fixing as from 20th July an overtime rate for female workers of 15 years and over. The weekly rates in the case of male workers aged 21 and over are 30s. per wk. of 51 hr., with overtime at 8d. per hr. In the case of females the rate for workers aged 15 and over is 5d. per hr., with overtime at 6d. per hr.

Essex.—An Order to operate as from the 20th July, fixing special rates of wages for employment on this year's corn harvest. The Order provides that male workers employed throughout the harvest on farms comprising more than 60 acres of corn shall be paid the ordinary minimum weekly rate, plus a bonus on completion of the harvest, which in the case of a worker aged 21 and over is £5 5s. 0d. In the case of male workers on such farms not employed fully on harvest, only a proportionate part of the bonus is payable. On farms comprising 60 acres or less of corn, male workers are to be paid at special hourly rates for all employment on harvest, the rate in the case of workers aged 21 and over being 10½d. per hr.

In the case of female workers, all employment on corn harvest is to be paid at special hourly rates, the rate for workers aged 21 and over being 7½d. per hr.

Norfolk.—An Order to operate as from the 20th July, fixing special rates of wages for the employment of male workers on this year's corn harvest. In the case of workers employed for the full harvest an inclusive wage is fixed to cover the harvest month, the amount in the case of workers aged 21 and over being £12. In the case of workers who do not work the full harvest the Order provides that they should be paid at the ordinary minimum rate with overtime payment at a special rate, which means that a worker aged 21 and over would receive the ordinary minimum rate of 29s. for a week of 50 hr., and for any extra hours worked 9½d. per hr.

Suffolk.—1. An Order amending the wording of the clause dealing with the guaranteed weekly wage for regular workers in the current Order, fixing minimum and overtime rates for male workers.

2. An Order to operate as from the 20th July, fixing special rates of wages for male workers employed on this year's corn

harvest. The Order provides that workers employed throughout the harvest on harvest work shall be paid, in addition to the ordinary weekly minimum rates, a bonus on completion of the harvest, the amount in the case of workers aged 21 and over being £6 3s. 4d. Provision is also made for the payment of a due proportion of the bonus to workers employed for only part of the harvest.

East Riding of Yorkshire.—An Order to operate as from the 20th July, fixing special overtime rates of wages for male and female workers employed on this year's corn harvest in lieu of the ordinary overtime rates. The special rate in the case of male workers aged 21 and over not boarded and lodged by the employer is 1s. 3d. per hr.; in the case of male workers boarded and lodged by the employer: foremen, waggoners, beastmen and shepherds, 1s. per hr.; lads 9d. per hr. and beginners 7d. per hr. The special rate for female workers under the Order is, in the case of workers aged 16 and over, 11d. per hr.

Copies of the Orders in full can be obtained on application to the Secretary of the Agricultural Wages Board.

Particulars of other Orders already made with regard to harvest rates of wages will be found in the issues of the *Journal* for June and July.

* * * * * *

Foot-and-Mouth Disease.—An outbreak of foot-and-mouth disease was confirmed on 3rd July on premises at Ottringham, near Hull. There were on the infected place 9 cattle and 7 pigs, of which 6 cattle were found affected with the disease. The origin of the outbreak is obscure. The slaughter of the stock was completed on the same day.

The usual Order was made imposing restrictions on the movement of animals within that part of the East Riding of Yorkshire within a radius of about 15 miles from the infected place.

* * * * * *

Leaflets Issued by the Ministry.—Since the date of the list given on page 95 of the April, 1925, issue of the *Journal*, the following leaflets have been issued:—

New.—No. 106. The Cultivation of Nuts.
,, 124. Cultivation of the Vegetable Marrow.
,, 125. Cultivation (and Diseases and Pests) of Melons.

Re-written.—No. 353. Oats.

Revised.—No. 1. The Black Currant Mite.
,, 129. Winter Egg Production.
,, 282. Scheme for the Improvement of Live Stock.

Amended.—No. 101. Prevention of White Scour in Calves.
,, 383. Hints on Goat-keeping.
,, 286. Narcissus Flies.

Mortality among Sheep after Dipping.—The Ministry announced on 22nd July, that with the development of double-dipping for the eradication of Sheep Scab, reports had come to hand from one district of deaths among sheep due to the use of poisonous dips.

The Ministry, therefore, wishes to repeat the warning to sheep-owners, published in the Press, first in July, 1920, and in the Leaflet (No. A.63/T.A.) "New Responsibilities of Sheep Owners," which has been widely distributed by the Police during the past two years.

Where their sheep have to be dipped in pursuance of the Ministry's Orders twice within a period of 14 days all owners are advised that, for the sake of safety, poisonous dips should not be used for both dippings. In cases where an owner prefers to select a poisonous dip for the first dipping, the Ministry desires to warn him that deaths may occur unless a non-poisonous dip is used for the second dipping. In cases where sheep-owners are prepared to run the risk of using arsenical dips for both dippings, the dip should be used at half its full strength for the second dipping. The Ministry takes no responsibility for any consequences which may arise from the selection of a poisonous dip. Farmers have the choice of a large number of effective non-poisonous dips.

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QUESTIONS IN PARLIAMENT.

Loans for Purchase of Farms.—In reply to a question in the House of Commons on 8th July, Mr. Guinness, on behalf of the Minister of Agriculture and Fisheries, stated that the Public Works Loan Commissioners, under the powers conferred on them by Section 1 of the Agricultural Credits Act, 1923, have advanced to farmers 638 loans, amounting to £2,545,946. The loans are repayable with interest at 5 per cent. per annum over varying periods not exceeding 60 years.

Agricultural Wages Act Prosecutions.—Colonel Day asked the Minister of Agriculture and Fisheries in the House of Commons, on 20th July, the number of prosecutions that have taken place for failure to pay the minimum rate of wage prescribed under the Agricultural Wages Act and the number of convictions secured, together with the amount of arrears ordered by magistrates to be paid?

Mr. Wood replied: I have authorised prosecutions in 11 cases, two of which have already taken place, and convictions secured in both cases. The arrears of wages ordered to be paid were £11 19s. 2½d. and £2 8s.

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REPLIES TO CORRESPONDENTS.

Mushrooms.— P.W., referring to the cultivation of mushrooms in cellars and caves, states that it is a practice with some growers to add about 8 lb. sulphate of ammonia to each ton of horse manure. He had also tried watering the beds with a solution of common salt at the rate of about 1 oz. to the gallon. Both processes appear to increase the yield, and he asks the reason.

Reply: The whole subject of mushrooms is by no means an easy one and there does not appear to be any good experimental work on the subject.

Mushrooms, it must be remembered, are not green (chlorophyllous) plants, consequently it is the organic (carbon-containing) part of their food that is important. The spawn lives for the most part on the organic compounds in the manure, and the idea that the manure is of importance principally on account of the heat produced is not right. One could not go on indefinitely growing this spawn—which is really the plant's vegetative body—on a restricted quantity of horse manure, because the organic compounds required would be exhausted. Another factor to be remembered in this connection is that the spawn in process of growth produces decomposition products, the accumulation of which would probably eventually render the old manure toxic. Then there are the fungi parasitic on the mushrooms (*i.e.*, the fructifications which grow on the spawn), which sooner or later would prevent profitable culture, were not fresh manure used.

As regards the addition of artificial fertilisers, mushrooms, like other vegetable growths, require nitrogen, phosphates and other elements of nutrition, and it is highly probable that these would also aid in the decomposition of the manure used as the basis. You might, therefore, try sulphate of ammonia at the rate you mention, both alone (in addition to the organic manure) and also in conjunction with an equal weight of superphosphate.

You allude to the action of salt. We can only tentatively explain this, but cannot guarantee the correctness of the explanation. The addition of common salt—and of various salts—would increase the strength of the solution outside the hyphæ (threads) of spawn. This would make it more difficult for the spawn to absorb water. It would tend to be in a condition of "physiological dryness." Now, in such conditions of dryness, whether physiological or physical, plants, on the whole, respond in many cases by diminishing vegetative activity and increasing reproductive activity. The production of more reproductive bodies (*i.e.*, the mushrooms and the spores borne on them) on the addition of salt solution, may be a response of this nature. It is also possible that by adding salt solution to the old manure, the oxygen thereby introduced may account for a good deal of the increased activity described.

Eradication of Worms in Lawns.—A.B. asked for a non-poisonous substance to eradicate worms.

Reply: The formula for a home-made solution frequently used is 1 peck of fresh quicklime to 40 gallons of water. In preparation the lime is placed in the water and after slaking has completely taken place, the mixture is allowed to stand until the slaked lime has all settled at the bottom. The clear liquid from the top is then taken and is used to water the lawn.

Soapsuds watered on the grass have also been reported to be effective in bringing the worms to the top, when they can be brushed away.

Winter Moth.—G.B. inquired as to the possibility of working some substance into the soil round fruit trees for the purpose of killing the chrysalids of winter moths, as grease-banding had not been found satisfactory.

Reply: No chemical has yet been discovered which, when dug into the soil round fruit trees, has given satisfactory results for the destruction of the chrysalids of winter moths. It has, however, been found that where poultry can be penned in the orchards, the birds will search out and destroy a large proportion of the chrysalids.

Grease-banding sometimes fails on account of insufficient care being taken to make certain that the winter moth females are unable to creep under the bands or to obtain access to the trees by some other route—as, for instance, by means of stakes, or even garden implements left temporarily leaning against the trunks. It must also be remembered that grease-banding will only deal with winter moths and one or two closely allied species. It has, for instance, no effect on the various other caterpillars which feed upon the foliage of fruit trees or upon aphides, which are commonly known as "blight."

Calcium Cyanide as an Insecticide.—J.G.W. inquired as to the possibilities of this substance as an insecticide.

Reply: It would not appear that any work has been done in this country on the insecticidal properties of calcium cyanide. The only cyanide in general use here is the sodium salt, which has now practically replaced potassium cyanide for the fumigation of glasshouses.

Greenhouse White Fly.—A.H.S. asked for information on the destruction of the White Fly (or Snowy Fly), *Aleyrodes vaporariorum*, which was attacking tomatoes and cucumbers in a glasshouse.

Reply: A leaflet was enclosed describing the hydrocyanic acid gas method of fumigation for its control, also a memorandum on an alternative gas, viz., tetrachlorethane. The latter is occasionally used when it is not possible to employ the very poisonous hydrocyanic acid gas through the structure to be treated opening into a dwelling house. In certain circumstances, however, tetrachlorethane will occasionally damage some kinds of plants.

It is possible that the feathery white substances which were found under the leaves are the cast skins of the larvæ. The ova are generally laid in circles and a stalk penetrates from each one into the tissues of the leaf. The larvæ themselves have quite superficially somewhat the appearance of aphides. Undoubtedly the larval stage is the harmful one, but opinion, so far as observations have been made in this country and abroad, agrees that the adult insect is also capable of effecting damage. The difference appears to be that whereas the larvæ cannot remove their stylets from the tissues, the adult insects are able to do so.

Detailed information on the insect itself is contained in a paper giving a critical study in the *Annals of Applied Biology* for January, 1915. It is probably safe to say that the greenhouse white fly has been known as a pest for the last fifty years. It is said to have been introduced from America. The tomato, though much affected, is not its only foodplant. Almost all greenhouse subjects are attacked.

Woodlice.—R.W.L. inquired as to the best means of eradicating woodlice from a vegetable store.

Reply: It would be best to lay poisoned bait for the woodlice. The following formula has emerged from some recent experiments as being the best for the purpose:—Oatmeal 50 parts, potassium bichromate 1 part, glucose 2 parts, water 30 parts.

It might also be convenient to provide alternative food to that the woodlice are destroying by using vegetables as traps. The most satisfactory for this purpose are red beet and mangolds. The roots should be cut in halves, with the cut sides placed downwards, the woodlice being collected every morning. This method has been found to maintain a quite satisfactory control.

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NOTES FOR THE MONTH.

Steam Cultivation.

FOR more than 50 years steam tackle has played a prominent part in tillage operations, and, in many parts of the country, more especially in the heavy-land, corn-growing districts, it still occupies first place in the farmer's estimation as an effective and expeditious means of preparing his land for crops.

An important part of the programme for increasing the country's food supplies during the war period was relegated to steam tackle. For this purpose one of the steps taken by the Food Production Department on its formation in January, 1917, was to mobilise the existing steam ploughing tackle and to provide for an increased supply at the earliest possible date.

Owing to difficulties of labour and lack of repair facilities, it was found that almost half of the 500 steam tackle sets in this country at the beginning of 1917 were not being used nearly as effectively as they should have been. These difficulties were overcome by the release from the Army of men experienced in steam tackle work, and by the provision of facilities for repairs, so that at the beginning of the summer of 1918 the whole of the 500 sets, excepting about 40 which were obsolete, were actually at work.

Sixty-five new sets of tackle were placed on order through the Ministry of Munitions with Messrs. J. Fowler, Ltd., of Leeds, and arrangements were made that they should be taken over by the Steam Cultivation Development Association for sale to members of that Association.

Each of these sets consisted of two 16-18 horse power engines, a 6-furrow plough, a trusser, an 11/13-tine cultivator, a water-cart, and a van complete with bedding for 6 men.

It was estimated that during the year 1918, 250,000 acres were ploughed, 880,000 acres were cultivated, and 23,000 acres were mole-drained by means of this scheme.

The decrease in the arable area in this country which followed the period of the War rendered it difficult for some of

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the steam tackle owners to keep their increased number of sets fully at work. During the present year, however, partly no doubt owing to weather conditions, steam ploughs appear to be more in demand than during the last three or four years.

Normally, steam tackle gets to work in dry weather in late spring, and continues throughout the summer and after harvest until wet weather stops it. Owing to unfavourable conditions up to the beginning of the recent dry spell, farmers found it impossible to deal with their fallows and there are, consequently, considerable arrears to be made up. During the fine weather hay-making and work among the roots occupied practically the whole time of all the labour available so that, in the absence of steam tackle, summer fallows could not receive the attention which every farmer knows they so well repay. Recently the corn harvest has been in full swing, and hay stubbles and corn stubbles will have to be dealt with, as well as the summer fallows, if full advantage is to be taken of the early season so as to get the winter corn sown in good time. It is in a season such as this that the use of steam tackle is so amply justified and so desirable. While the choice of a variety may make a difference in yield of 5 to 10 per cent., corn sown in September or by about the first week in October may yield anything up to 50 per cent. more than corn sown later in the year or in spring. Every week makes a difference.

In dry, settled weather the steam cultivator will speedily and efficiently produce a first-class fallow, but under rainy or unsettled conditions, and especially when dealing with a hay stubble, the steam plough is usually the better implement.

There is another important operation for which the steam cable system is pre-eminently suitable, namely, sub-soiling. Wherever there is a hard " pan "—and pans due to repeated horse-ploughing at the same depth, to deposits of iron compounds, etc., are of frequent occurrence—then this pan must be shattered before the soil will give of its best in all seasons. The predominant factors in plant growth are soil moisture and air; and the balance between the two must be properly adjusted.

Where a pan exists the soil is liable to become water-logged in wet weather, air is excluded and the plant languishes or dies. In such conditions plants are always shallow-rooted and as the top soil dries quickly in hot weather the crop soon begins to feel the effects of drought, for owing to the pan water cannot reach the plant from below.

When the pan is broken up both water and air can reach the lower layers, plants can enjoy a healthier and more extensive root-range and in times of drought water from below is accessible to them. In this connection too it is important to remember that when a plant, just like an animal, is in a position to make uninterrupted growth it is capable of resisting the attack of most diseases or pests.

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Report of the Fertilisers and Feeding Stuffs Advisory Committee.

THE presentation of the Report of the Fertilisers and Feeding Stuffs Advisory Committee (Cmd. 2470, price 9d. or 9½d. post free), marks a further stage in the preparation of new legislation to replace the Fertilisers and Feeding Stuffs Act, 1906.

A Departmental Committee reported last year that a revision of the present Act is necessary, and outlined the method and extent of the control which should, in their opinion, be exercised over the trade in fertilisers and feeding stuffs. Further, they recommended that Schedules should be prepared showing the articles to which the new legislation should apply, and the nature of the particulars to be warranted in the case of each.

The formulation of these Schedules has been the principal part of the duties of the Advisory Committee, but recommendations have also been made on certain other points. The Committee are of opinion, for instance, that the time has come to cease official use of the expression "phosphates" in connection with fertilisers and to work in terms of phosphoric acid, as is usual on the Continent and elsewhere.

The Committee, of which Lord Clinton was Chairman, consisted of representatives of farmers and traders, agricultural and scientific advisers and nominees of the Ministry of Agriculture and Fisheries, the Board of Agriculture for Scotland and the County Councils' Association. As their Report is a unanimous one it is, perhaps, not too much to hope that the Committee's conclusions will meet with the substantial concurrence of all the many interests concerned.

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Farm Institute Courses.

A LEAFLET (Form No. 732/T.E.) showing the types of instruction which will be available at Farm Institutes during the session of 1925-6 has been issued by the Ministry. The leaflet gives the names of the farm institutes, a short description of the courses at each, the fees payable, either for tuition only, or for board, lodging and tuition, as the case may be, and the address to which inquiries for further particulars should be sent.

Copies may be obtained free of charge, and post free, on application to the Ministry, 10, Whitehall Place, London, S.W.1.

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Tuberculosis in Cattle: Disposal of Carcasses.

WITH a view to ensuring that the carcasses of animals slaughtered under the Tuberculosis Order of 1925 should not be disposed of for human consumption without adequate safeguards being designed for protecting public health, the Ministry of Agriculture has issued an Order providing that, in any case in which the carcass is intended to be used for human consumption, a copy of the notice of intended slaughter sent to the owner shall also be sent to the appropriate officer of the Sanitary Authority of the district, together with a statement of the address of the premises on which, and the time at which, it is intended to carry out the slaughter.

The Order also provides that in such cases the carcass, or any part of it, shall not be removed from the premises or be disposed of for human consumption, without the consent in writing of the Medical Officer of Health or other competent officer of the Sanitary Authority.

It is intended that a sufficient time should be allowed to elapse before slaughter to enable the Medical Officer of Health, or other competent officer, to be present at the post-mortem examination. At the same time, the Ministry trusts that such arrangements will be made as will ensure that the examination of the carcass is not delayed, since delay would prejudice the sale of any portion of the carcass which might be passed.

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Relief of Unemployment: Winter, 1925-26.

THE Ministry is now able to announce that His Majesty's Government have decided that the grants for Land Drainage schemes for the relief of unemployment, similar to those carried out during the past four winters, shall be continued during the coming autumn and winter.

The voluntary schemes will be conducted generally on the same lines as before through the agency of the County Agricultural Committees, but in view of the small sum of money available, it will not be possible to provide any grants towards drainage works in areas under the jurisdiction of a Drainage Authority.

As announced, however, in the House of Commons on 6th August, the Minister has under consideration proposals for a more permanent scheme of improvement by land drainage to be carried out by Drainage Authorities, but he is not yet in a position to put this into operation.

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Seed Potato Certificates.

FARMERS who think of selling seed potatoes must remember that it is necessary in the first place to get either a "Clean Land" or a "Purity" certificate from the Ministry. If the potatoes are of immune varieties, it is best to get a "Purity" certificate. These are issued after an inspection of the growing crop, and immediate application should be made to the Ministry, since the inspection cannot be undertaken after the haulm had died down. "Clean Land" certificates do not involve inspection except as regards crops grown in Wart Disease infected areas or near cases of the disease. If inspection is necessary, it must be made when the crop is being lifted and growers in the districts mentioned should apply early so that the necessary arrangements can be made.

All concerned with potato growing should remember that it is illegal to sell any potatoes for planting or to plant any purchased potatoes which are not the subject of either a "Clean Land" or a "Purity" certificate.

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Coloured Wall Diagrams of Plant Pests and Diseases.

To meet the need for good and technically correct diagrams of pests and diseases which attack agricultural and horticultural crops, the Ministry has produced the first four of a series of coloured wall diagrams. The subjects illustrated are:—(1) Apple Blossom Weevil; (2) Winter Moths; (3) Apple and Pear Scab, and (4) Silver Leaf. The diagrams measure 30 in. by 20 in. and are beautifully executed by the four-colour process. They are scientifically exact, attractive, clear and artistic. A reduced reproduction in black and white of the first of these is given herewith.

Of their kind, the diagrams now produced are unique, and should prove highly valuable to agricultural, horticultural and allotment societies; to Local Education Authorities for use in rural schools; to museums, colleges and public schools; to farmers and fruit growers; and to private individuals. The price of each diagram is 3s. unmounted, 5s. mounted and on rollers (post free). A descriptive leaflet is issued free with each diagram.

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Agricultural Scholarships and Agricultural Research Scholarships.

THE Ministry has awarded the following scholarships to post-graduate students:—

(1) For training as Agricultural Organiser, Lecturer, etc.:—

Name.	*Subject of Study.*
J. L. Davies, B.Sc. (Wales)	Agricultural Economics.
W. N. Jones, B.Sc. (Wales)	Animal Husbandry.
A. Rowlands, B.Sc. (Wales)	Dairying.
(Miss) A. P. Wilson, B.Sc., A.R.C.Sc. (Lond.)	Diseases of Glasshouse Crops.

(2) For training as Agricultural Research Worker:—

Name.	*Subject of Study.*
W. M. Davies, B.Sc. (Wales)	Agricultural Entomology.
C. E. Marshall, B.Sc. (Manchester) ...	Soil Chemistry.
H. J. Meredith, B.Sc. (Wales)	Agricultural Economics.
B. G. Peters, B.Sc. (Bristol)	Agricultural Zoology.
E. L. Taylor, B.Sc., M.R.C.V.S., D.V.H. (L'pl.)	Veterinary Science.

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Fig. 1. Reduced reproduction in black and white of coloured Wall Diagram No. 1.

The Agricultural Index Number.

THE general level of the prices of agricultural produce was further reduced during July, mainly as a result of the lower prices of wheat, fat sheep and potatoes. On the average agricultural produce was selling at 51 per cent. above the prices in July, 1911-13, this being a drop of 4 points on the month, and 19 points below the level of January last. In July last year the index number was 52 per cent. above pre-war, so that the rise which took place last autumn has now been lost.

In the following table are shown the percentage increases as compared with pre-war prices each month since January, 1920:—

PERCENTAGE INCREASE COMPARED WITH THE AVERAGE OF THE CORRESPONDING MONTH IN 1911–13.

MONTH.	1920.	1921.	1922.	1923.	1924.	1925
January ...	200	183	75	68	61	70
February ...	195	167	79	63	61	67
March ...	189	150	77	59	57	65
April ...	202	149	70	54	53	58
May ...	180	119	71	54	56	57
June ...	175	112	68	51	58	55
July ...	186	112	72	53	52	51
August ...	193	131	67	54	59	—
September	202	116	57	56	60	—
October ...	194	86	59	51	63	—
November	193	79	62	53	64	—
December	184	76	59	56	63	—

Wheat averaged 11d. per cwt. less than in June, and the average of 11s. 11d. per cwt. was exactly the same as in July last year. Barley was 1s. 4d. per cwt. cheaper than a year earlier, but oats were 5d. per cwt. dearer, both barley and oats being 34 per cent. above July, 1911-13, with wheat relatively dearer at 47 per cent. above.

Fat sheep declined by 1d. per lb. on the month, the index number being reduced from 93 per cent. above pre-war to 79 per cent. above, this being the lowest index figure for fat sheep since April, 1924. Fat cattle also became cheaper and, although a fall is usual in July, the decrease this year was relatively rather greater than in the basic years, and the index number declined by 2 points. Fat pigs were practically unchanged in price, but as there was a rise in July in the basic years the index numbers declined slightly.

The demand for dairy cows improved considerably when milk yields fell off owing to the dry state of the pastures, and prices advanced by £1 per head. The shortage of grass had the opposite effect with store cattle, which became very difficult

to sell and averaged 15s. per head less than in June. Store sheep still remained very dear at more than double pre-war prices. Young pigs at 53 per cent. above pre-war were at relatively much the same level as fat pigs.

The index number for milk advanced by 2 points owing to a slightly higher average price for contract milk delivered to Manchester, prices being unchanged at London and Birmingham. Butter rose sharply, the advance on the month being 2¾d. per lb., and at 73 per cent. above pre-war the index number was 13 points higher than in July last year. On the other hand cheese declined by 9s. 6d. per cwt., and at 70 per cent. above 1911-13 was 20 points lower than a year earlier. The rise of 3d. per dozen in egg prices was relatively sharper than in pre-war years, and the index figure advanced to 61 per cent. above July, 1911-13, but was slightly lower than last year.

The markets were fully supplied with early potatoes during July and prices were low, the average wholesale price being only £7 19s. per ton or £2 2s. 6d. per ton cheaper than last year, and only 43 per cent. dearer than in July, 1911-13. Hay prices have varied very little from month to month for some considerable time; during July prices were slightly lower than in the previous month.

Index numbers of different commodities during recent months and in July, 1923 and 1924, are shown below:—

PERCENTAGE INCREASE AS COMPARED WITH THE AVERAGE PRICES RULING IN THE CORRESPONDING MONTHS OF 1911-13.

	1923.	1924.	1925.			
Commodity.	July.	July.	April.	May.	June.	July.
Wheat ...	39	47	62	59	62	47
Barley ...	12	52	38	36	38	34
Oats	41	28	34	36	38	34
Fat cattle ...	45	54	50	49	50	48
Fat sheep ...	72	97	100	100	93	79
Bacon pigs ...	49	31	68	60	54	51
Pork " ...	59	31	67	60	53	52
Dairy cows ...	49	56	47	48	47	50
Store cattle ...	28	51	39	40	43	42
Store sheep ...	109	132	100	99	115	115
Store pigs ...	113	28	64	55	55	53
Eggs... ...	36	65	51	48	52	61
Poultry ...	79	80	50	55	61	75
Milk	57	50	58	55	55	57
Butter ...	37	60	64	54	57	73
Cheese ...	54	90	61	70	78	70
Potatoes ...	66	81	115	124	76	43
Hay	38	1	—2*	3	3	0

* Decrease.

LIVE STOCK IMPROVEMENT SCHEME.

REPORT FOR THE YEAR ENDED 31ST MARCH, 1925.

DURING the year ended 31st March, 1925, the Live Stock Improvement Scheme continued to operate on the usual lines described in previous reports, and on the whole satisfactory progress was made. Although the scheme has been in operation for eleven years there are still many districts in which, even if it has been heard of, the scheme has not yet been given a trial. This has been due, in some measure, to the difficulty of persuading a conservative industry to adopt new ideas or change its methods, and it is due also to the fact that the districts allotted to the Ministry's Live Stock Officers have been somewhat large. The recent appointment of additional officers and the revision of the districts into which the country is divided will, it is hoped, enable further progress to be made both in opening up fresh ground and in establishing the good work which has already been accomplished. The Live Stock Scheme comprises a great deal beyond interesting the farmer in the use of a good sire and, as regards his cows, in the keeping of milk records—which are the two main principles of the scheme. To educate the farmer so that the selection of good animals for breeding becomes not only a capability but a habit; to make suitable feeding an intelligent custom instead of a tedious theory; to foster a willingness to incur initial expenditure for the sake of ultimately better returns; in short, to demonstrate all the correlated requirements of "grading up," and the commercial soundness of them; these are objects which must take several years to accomplish, but toward which the Live Stock Scheme may fairly be said to be making good progress.

Bulls.—The Bull Scheme has continued to be popular, and with the relaxation of foot-and-mouth disease restrictions, which hampered development in the preceding year, satisfactory progress has been made.

The total number of bulls actually located for service during the year ended 31st March, 1925 (*i.e.*, continued from the previous year with renewed grants or provided for fresh districts during the year), was 1,069, an increase of 91 on the preceding year.

BULL SCHEME.

(Showing the Number of Bulls subsidised each Year since the Commencement of the Scheme.)

Year. 1st April—31st March.	*Societies.*	*Individuals.*	*Total No. of Bulls.*
1914-15*	369	43	497
1915-16	489	28	633
1916-17	543	15	659
1917-18	578	14	710
1918-19	604	7	721
1919-20	568	6	675
1920-21	561	6	668
1921-22	726	3	847
1922-23	831	1	947
1923-24	840	1	978
1924-25	916	1	1,069

The Bull Scheme is beginning to have a marked effect in districts where it has operated for some time. The improvement effected in the quality of stock reared continues to be proved at markets and sales, and the introduction of special classes at shows for premium bulls and their progeny is an encouraging recognition of the scheme. A good instance of this was provided at the Yorkshire Agricultural Society's Show in July, 1924, at York, where arrangements were made for a special class for premium bulls. Twenty bulls were entered and eighteen were shown. The class was reported as being very strong, not only as regards the number but also the quality of the bulls shown, and constituted in the opinion of many the most interesting feature of the show. Considerable interest was created among local breeders, and it was decided to provide for a similar class at the Society's next show. It is worthy of mention that three of the bulls shown were themselves the progeny of premium bulls. Another example was provided at an agricultural show at Bakewell, where a group class was organised in which premium bulls were shown with two each of their progeny. Nine such groups came before the judges, and this feature of the show was reported to be a great success.

The effect of these and other similar demonstrations of the quality of stock used under and produced by the scheme is considerably enhanced by the successes obtained by premium stock in the open classes at shows throughout the country. These happenings are not without effect on the minds of farmers who have not hitherto given the scheme a trial, and the Ministry's Live Stock Officers are able to report a growing interest in the selection of bulls used, often outside the scheme,

* Including the period 1st February, 1914—31st March, 1914.

and while in many districts there is still a regrettable lack of care in the breeding of live stock the conditions to-day as compared with those in existence before the inauguration of the scheme are, on the whole, distinctly promising. A further indication of an awakening interest in live-stock breeding and the use of a good sire may be found in the more frequent representations which are being made to the Ministry with regard to the question of eliminating the scrub bull. The Ministry is fully in sympathy with the object of these representations, and when it has sufficient agricultural support it will be prepared to proceed with the necessary legislation. Some such action would seem to be necessary in the future, as the Ministry's scheme, though it is doing good work in the desired direction, is very limited in its scope by reason of expense. The magnitude of the task will be easily appreciated when it is remembered that the number of bulls subsidised by the Ministry is about one thousand as compared with the total number of bulls in the country, estimated to be about 82,000.

Prices.—As will be seen from the following table the average price of bulls used under the scheme showed a small decrease on that of the previous year. The Shorthorn continues to be the most popular breed, and more than half the sires subsidised are of that breed.

NUMBERS AND PRICES OF BULLS OF EACH BREED.

Breed	1914-15		1923-24		1924-25	
	No.	Average Cost	No.	Average Cost	No.	Average Cost
		£ s. d.		£ s. d.		£ s. d.
Aberdeen-Angus	–	–	–	–	1	52 10 0
British-Friesian	–	–	5	74 16 0	6	53 14 0
Devon	16	40 17 6	106	57 16 0	115	58 11 0
Guernsey ...	–	–	12	51 10 0	13	47 13 0
Hereford ...	63	33 7 6	100	50 19 0	105	50 2 0
Lincoln Red ...	33	31 10 0	101	55 11 0	116	51 19 0
Red Poll ...	–	–	–	–	2	28 0 0
Shorthorn ...	337	37 17 0	573	57 10 0	593	55 5 0
South Devon ...	6	36 11 6	15	47 5 0	11	38 13 0
Sussex ...	–	–	–	–	1	44 2 0
Welsh Black ...	35	29 9 0	62	52 1 0	63	47 6 0
All Breeds ...	497*	36 0 0	974	56 3 0	1026†	53 18 0

* Including 7 "other breeds."

† 1,069 bulls were located, but grants in respect of 43 were in suspense at the end of the year.

Service Fees.—The service fees varied little from the previous year. About one-half of the bulls served at a fee of 5s., and the average service fee for all the bulls was the same as in the preceding year, viz., 5s. 3d.

Year	2/6	3/-	3/6	4/-	4/6	5/-	5/6	6/-	6/6	7/-	7/6	8/-	8/6	9/-	10/-	Over 10/-
1914-15	265	57	41	42	3	88	–	–	–	–	1	–	–	–	–	–
1923-24	51	46	25	71	9	491	2	84	2	12	126	6	7	1	26	5
1924-25	54	46	21	78	7	539	4	95	3	8	135	6	8	1	15	6

Boars.—Notwithstanding the slight increase shown in the number of boars available during the year ended 31st March, 1925 (*i.e.*, continued from the previous year with renewed grants or located in fresh districts during the year), the year was not on the whole a satisfactory one for pigs. In the first part of the year the drop in the price of pigs caused a reduction in breeding, and although the number of boars used under the Ministry's scheme has been maintained, Live Stock Officers report that the number of sows served has generally been below the average.

BOAR SCHEME.

(Showing the Number of Boars subsidised each Year since the Commencement of the Scheme.)

Year 1st April to 31st March	*Societies*	*Individuals*	*Total No. of Boars*
1914-15*	115	–	115
1915-16	180	–	193
1916-17	186	15	216
1917-18	172	92	264
1918-19	156	167	350
1919-20	120	225	399
1920-21	135	285	441
1921-22	113	416	550
1922-23	93	451	569
1923-24	78	541	638
1924-25	68	587	655

Fluctuations in pig breeding are probably less marked where the existence of a bacon factory renders the demand for suitable pigs more constant. In such districts a steady demand for a definite type tends to stabilise the industry both as regards the number and type of pig produced, while in many parts of the country some difficulty seems to exist among breeders in deciding on the type of pig that should be produced, and the type of boar that should be used. Local preferences for particular types (sometimes not recognised as distinct breeds by the Ministry) contribute not a little to the difficulty of developing this section of the Ministry's Live Stock Scheme.

* Including the period 1st February, 1914–31st March, 1914.

Toward the latter part of the year there were indications of a revival in pig breeding, and with it the demand for boars under the scheme will again revive.

Prices.—The most popular breeds continued to be Large White, Middle White and Large Black, although in the case of the Large Black pig there was a further and very noticeable drop. A similar decline is noted in connection with the Gloucestershire Old Spots breed. It will also be seen from the following table that the average prices paid for all breeds have slightly decreased :—

NUMBERS AND AVERAGE PRICES OF BOARS OF EACH BREED.

Breed	1914-15				1923-24				1924-25			
	No.	Average Price			No.	Average Price			No.	Average Price		
		£	s.	d.		£	s.	d.		£	s.	d.
Berks	10	8	0	0	10	17	1	9	15	13	3	5
Cumberland	—	—			29	14	5	3	33	12	9	4
Essex	—	—			5	19	9	9	4	18	2	9
Glos. Old Spot ...	7	7	1	0	32	15	8	3	22	14	18	3
Large Black	18	7	5	6	138	13	4	4	103	12	1	2
Large White	64	7	3	0	250	14	11	9	247	13	16	10
Lincoln Curly Coat ...	4	8	4	6	35	11	16	10	27	10	17	11
Middle White ...	12	6	17	0	98	14	16	9	111	14	5	0
Large White Ulster ...	—	—			6	16	6	8	7	15	19	3
Tamworth	—	—			2	18	18	6	2	18	2	0
Wessex Sandleback ...	—	—			14	14	12	6	22	13	5	7
Welsh	—	—			—	—			24	11	16	1
All Breeds	115	7	5	3	619	14	6	2	617*	13	8	1

Service Fees.—The service fees, ranging from 2s. 6d. to 10s. varied very little from the previous year. More than one-half the boars served at a fee of 5s., and the average fee for all the boars was 5s. 4d.

Year	2/-	2/6-	3/-	3/6-	4/-	4/6-	5/-	5/6-	6/-	6/6-	7/-	7/6-	8/-	8/6-	10/-
1914-15	21	62	10	5	6	—	2	—	—	—	—	—	—	—	—
1923-24	—	9	9	12	44	1	368	1	58	2	4	104	—	2	5
1924-25	—	9	10	14	45	4	371	2	52	3	2	100	—	1	4

Heavy Horses.—As stated in last year's Report, the decision to revive the grants to Heavy Horse Societies was made somewhat late, and in consequence full advantage could not be taken of the scheme for the service season of 1924. Particulars furnished to the Ministry in connection with applications for

* 655 Boars were located, but grants in respect of 38 were in suspense at the end of the year.

these grants served to show how adversely Heavy Horse Breeding had been affected during the period which followed the withdrawal of the Ministry's assistance. About eighty per cent. of the societies subsidised by the Ministry in 1921-22 were formed as a direct result of the scheme, and some of them dropped out when the Ministry's grant was discontinued. It is hoped, however, to secure their revival now that the grants have been restored.

The serious decline in horse breeding generally is reflected in the reduction in recent years in the number of stallions licensed under the Horse Breeding Act, 1918, which are given later in this report, and also by the decrease in the number of foals as shown in the Annual Returns furnished to the Ministry. In 1920 the number of horses under one year old given in the Annual Returns was 97,298, and this number has decreased each year until in 1924 the number was 54,700. It is noteworthy that the decrease since 1922 was more than double that between 1920 and 1922.

In view of these conditions it is not surprising to find that several societies have been unable to carry on without the Ministry's assistance and that others have been operating with considerable difficulty. The Ministry's grants may do something to arrest further decline in the breeding of heavy horses, and with the provision which has now been renewed for assisted nominations it is hoped that the smaller farmer, for whose assistance the scheme was primarily intended, will be encouraged to start afresh.

The following table shows the progress made under the Heavy Horse Scheme since its inauguration :—

Year	*No. of Stallions*	* *Total No. Mares served*	* *Averag No. of Mares served*	*No. of assisted Nominations*	*Average Hiring Fee of Stallions*	*Average service Fee*
					£	£ s. d.
1914-15	72	6,365	68	1,503	231	2 8 6
1915-16	97	9,122	94	2,430	241	2 9 6
1916-17	108	9,995	92	2,181	244	2 11 0
1917-18	110	10,556	96	2,151	258	2 16 3
1918-19	122	12,281	100	2,165	285	2 15 8
1919-20	118	10,920	96	1,996	317	3 6 3
1920-21	105	9,133	87	1,839	345	3 13 1
1921-22	101	7,888	78	1,943	333	3 13 7
1924-25	87	6,098	70	†—	178	2 7 0

* Excluding the Cumberland and Westmorland Heavy Horse Society, which was formed in 1916 for the purpose of issuing only assisted nominations to selected stallions. The figures for this Society were as follows :—

Year	*No. of Assisted Nominations*	*Year*	*No. of Assisted Nominations*
1915-16	... 385	1919-20	... 264
1916-17	... 394	1920-21	... 254
1917-18	... 328	1921-22	... 255
1918-19	... 321	1924-25	... 121

The decline in the number of assisted nominations issued by this Society is due to the increased service fees which automatically increased the value of an assisted nomination and consequently reduced the number available from the Ministry's grant. In 1924-25 the Ministry's grant was reduced to one-half the amount given in previous years, hence the further decrease in the number of nominations issued.

† No grant was made by the Ministry for assisted nominations (except to the Cumberland Society) for the year 1924-25.

Horse Breeding Act, 1918.—As stated above in connection with the Heavy Horse Breeding Scheme there has been a continued decline in the number of stallions licensed each year since the Horse Breeding Act came into operation in 1920. The figures are as follows:—

Year (ending 31st Oct.)	*No. of Applications for Licences.*	*No. of Licences issued.*	*No. of Refusals.*
1920	4,153	3,749	404
1921	4,060	3,816	244
1922	3,644	3,479	165
1923	2,897	2,761	136
1924	2,285	2,210	75

Of the 2,210 stallions licensed in 1924, 2,019 were pedigree animals and the remaining 191 were horses that were not entered or accepted for entry in any recognised stud book.

The following tables show the number of stallions of each breed concerned that were licensed or rejected, and the number refused licences in respect of the various prescribed diseases or defects:—

NUMBER OF STALLIONS LICENSED OR REFUSED.

	Pedigree.		*Non-Pedigree.**	
Heavy.	*Licensed.*	*Refused.*	*Licensed.*	*Refused.*
Shire	1,151	47	44	1
Clydesdale	148	5	2	1
Suffolk	173	7	2	—
Percheron	53	1	1	—
Others	—	—	45	2
Light.				
Hackney	148	4	30	–
Thoroughbred	147	5	2	–
Arab	19	1	3	–
Hunter	4	–	4	–
Cleveland Bay	7	–	–	-
Yorkshire Coach	1	–	–	–
Welsh Roadster	1	–	1	–
American Trotter	–	–	8	–
Others	–	–	11	–
Ponies (including Welsh Cobs)	167	1	38	–
Totals	2,019	71	191	4

* Non-pedigree stallions are arranged as far as possible under types.

NUMBER OF STALLIONS REJECTED FOR THE PRESCRIBED DISEASES AND DEFECTS.

Roaring	20	Defective Genital Organs	3
Whistling	23	Stringhalt	2
Sidebone	12	Shivering	1
Cataract	8	General Unsuitability	1
Ringbone	1		
Bone Spavin	4	Total	75

Fourteen appeals were made against refusals of licences, and in ten cases these were successful.

There is no doubt that the number of unsound stallions, which formerly travelled at very low fees and were a menace to the improvement of the horse breeding industry, have been practically eliminated from the road, and very few cases of infringement of the Act are now reported.

Sheep.—The financial assistance which the Ministry has given since 1919 towards the improvement of Welsh Mountain Sheep was continued during the year under review. Grants, up to a maximum of £10 for each ram provided, at the rate of 3s. 4d. per ewe served, were made to 13 societies in respect of 17 approved pedigree rams. The average hiring fee of the rams was £9 15s., and the average service fee 1s. 5d. The number of ewes served was 1,021, an average of 60 per ram.

Live Stock Officers report that the hill farmers are taking a keen and active interest in the operations of the sheep societies, which, it may be justly claimed, have been instrumental in directing the attention of flock owners to the importance of selecting suitable rams. Some of the hired rams and their progeny have been very successful in the show ring, and it is interesting to note that some of the sheep improvement societies conduct shows of their own for the exhibition of their lambs.

Milk Recording.—The Milk Recording movement has continued to make steady progress, as will be seen from the following table :—

	*Year.**	*Societies.*	*Members.*	*Herds.*	*Cows.*
1st April to 31st March	1914-15	16	264	306	7,331
	1915-16	20	350	398	9,811
	1916-17	22	441	495	12,950
	1917-18	25	503	555	14,404
1st October to 30th September	1917-18	27	639	708	19,793
	1918-19	38	1,191	1,332	37,880
	1919-20	46	2,075	2,312	61,323
	1920-21	52	3,328	3,664	97,903
	1921-22	55	3,949	4,362	117,023
	1922-23	55	4,365	4,767	127,151
	1923-24	52†	4,764	5,209	138,086

* Before 1st October, 1917, there was no uniform year for Societies.

† The decrease in the number of societies is due to amalgamation.

Opportunities have been taken during the year of effecting amalgamation in some cases where more than one society existed within a county. Experience has shown that a strong society for one county—one whose interests are less parochial—can usually be more efficiently and economically worked than a smaller society, and can more easily undertake the development of areas where the milk recording movement has not yet been established.

Average Yield of Herds Recorded.—The annual returns furnished by the 52 societies for the recording year ended 1st October, 1924, show that of the 138,086 cows and heifers recorded, 53 per cent. were cows which had been retained in the herds for the full year, and that the average yield of these 73,338 cows was approximately 7,030.1 lb. The appreciable advance which was made in this direction last year has thus practically been maintained. The following table compares the average annual yield of (1) all cows and heifers recorded, and (2) of the cows recorded for the full year for each year since the uniform milk recording year was fixed :—

Year: 1st October to 1st October.	No. of Societies.	Particulars of all Cows and Heifers recorded.			Particulars of Cows recorded for full Year.			
		No. of Cows and Heifers.	Total Yield.	Average Yield.	No. of Cows.	Percentage of Total Cows.	Total Yield.	Average Yield.
			gal.	gal.			gal.	gal.
1917-18	27	19,793	8,426,958	426	8,775	44	5,255,923	599
1918-19	38	37,880	16,204,941	450	17,989	47	10,543,516	579
1919-20	46	61,323	29,344,887	479	27,266	44	17,363,347	637
1920-21	52	97,903	48,512,380	495	48,248	49	30,892,620	640
1921-22	55	117,023	60,463,617	517	63 318	54	41,208,073	651
1922-23	55	127,151	67,904,224	534	68,349	54	46,956,565	687
1923-24	52	138,086	73,963,165	535	73,338	53	50,299,884	685

While the average annual yield of full-year cows for all societies has improved very gradually since the uniform milk recording year was fixed in 1917-18, the average in the case of some individual societies has shown very marked improvement. The following table illustrates the progress made in typical cases, and the cash value of such progress on the basis of one shilling per gallon of milk :—

Society	*No. of years during which records were taken*	*Average yield per cow in 1st year*	*Average yield per cow in last year*	*Increase in annual yield per cow*	*Number of cows in last year of period*	*Cash value of increase of last year over 1st year at 1/- per gallon*	
						Per cow	*On total No. of cows*
		gal.	gal.	gal.		£ s.	£ s.
A	6	595	705	110	632	5 10	3,476 0
B	4	582	722	140	935	7 0	6,545 0
C	4	522	690	168	681	8 8	5,930 8
D	5	567	761	194	1,780	9 14	17,266 0

With individual herds even more striking results have been obtained, and the following typical cases of herds of over 20 cows are of considerable interest :—

Herd	*No. of years during which records were taken*	*Average yield per cow in 1st year*	*Average yield per cow in last year*	*Increase in annual average yield per cow*	*Number of cows in last year of period*	*Cash value of increase of last year over 1st year at 1/- per gallon*	
						Per cow	*Per herd*
		gal.	gal.	gal.		£ s.	£ s.
A. (Non-pedigree Shorthorn)	5	589	793	204	21	10 4	214 4
B. (Non-pedigree Shorthorn)	7	524	821	297	30	14 17	445 10
C. (Pedigree Devon)	7	353	574	221	34	11 1	375 14
D. (Mixed Shorthorn and Friesian)	6	616	1,004	388	20	19 8	388 0
E. (Cross-bred, mainly Shorthorn)	4	364	711	347	46	17 7	798 2

These particulars bear testimony to the commercial value of the milk recording scheme, and as there is no reason to suppose that what has been achieved in many herds could not with the same care and attention be accomplished in most herds, the possibilities of the movement from the point of view of increased production of milk alone fully justify the efforts which have been made to promote this section of the Live Stock Scheme.

Competitions and Sales.—The institution of competitions for recorded herds, some of them carrying substantial awards, and the prominence now usually given to milk records in sale catalogues, are good testimony to the value attached to milk recording by those who have been interested in the movement long enough to have proved its advantages.

Although there has been no repetition of the boom in prices which occurred in 1921, the prices still obtained by non-pedigree recorded cattle compare very favourably with those given for pedigree animals. The following recent instances may be quoted in this connection.

At a sale in November, 1924, at Brenchley, Kent, 53 non-pedigree cows sold at an average of £46, the highest prices being 82, 76 and 60 guineas.

At Stony Stratford, 57 non-pedigree cows realised an average of £51, the highest prices being 100 guineas (twice) 88, 69, 65 and 60 guineas.

At a sale at Castleton, Monmouthshire, an average of 50 guineas was paid for 30 non-pedigree Shorthorns. Five realised over 70 guineas and one 185 guineas.

Register of Dairy Cattle.—The eighth volume of the Ministry's Annual Register of Dairy Cattle has been issued, covering the milk recording year ended 1st October, 1924. It is hoped that the Register will be of assistance to persons anxious to obtain dairy cattle with good milking records or the progeny of such animals, and of commercial value also to the owners of the cows and bulls entered in the Register. Twenty recognised breeds or types are represented in the volume, 62 per cent. being of the Shorthorn type, 17 per cent. Friesian, 3 per cent. Guernseys, and 5½ per cent. Crossbred. In order to make the publication a more useful work of reference the Ministry made in the last issue important changes in the conditions of entry and distribution, which may be summarised as follows:—

Cows.

1. In place of the former uniform standards of yield, *i.e.*, 8,000 lb. for one year or 6,500 lb. average for two or more consecutive years, different standards have been fixed for the various breeds as follows:—

Breed or type.	*Yield (in lb.).*
Friesian	10,000
Ayrshire	9,000
Blue Albion	9,000
Lincold Red Shorthorn	9,000
Red Poll	9,000
Shorthorn	9,000
Crossbreds	9,000
All other breeds or types	8,000

2. The issue of a certificate of milk record is no longer a condition of entry.

3. Cows will be selected by the Ministry from the particulars furnished by members of Milk Recording Societies operating under the Ministry's Scheme, and if a greater number of cows give yields of or above the prescribed standards of their breeds than can be included in the Register, the highest yields of each breed only will be entered, regard being had to the percentage of animals eligible in each breed.

4. Cows in respect of which Certificates of Merit have been issued will be entered in the Register without further application from the owner, provided that (*a*) the certificate is for the period of three years ending with the Milk Recording Year in respect of which the Volume is issued, and (*b*) application for the certificate is received by 31st December following the close of that Milk Recording Year.

Bulls.

5. A bull must either be entered or accepted for entry in the Herd Book of its breed, and its dam and sire's dam must have given the standard yield prescribed for their breed or type in any particular year, or it must be entered or accepted for entry in the Herd Book of its breed and two or more of its daughters must have given the standard yield prescribed for their breed or type in any particular year.

6. No charge is made for entry of any cow or bull in the Register.

7. A copy of Volume 8 will be issued free to all members of Milk Recording Societies, and will be on sale to the public at 1s.

It is hoped that the revised arrangements, providing as they do for a much wider circulation of the Register, will create a greater interest and prove of much greater use.

Over 13,000 cows qualified for entry in Volume 8 of the Register on the above conditions, and of these 5,000 of the highest yielding cows were selected for inclusion in the printed volume. Practically all the cows entered have yielded 9,000 lb. or over in the year; 62 per cent. yielded between 10,000 and 12,000 lb., 23 per cent. between 12,000 and 14,000 lb. and 7 per cent. between 14,000 and 20,000 lb. Twenty-three cows gave 20,000 lb. or over.

Seventy-seven cows with certificates of merit are included in the volume, but the entry of bulls was very disappointing, only three being entered.

Milk Record Certificates.—There was a further considerable drop in the number of certificates issued, the number being 633 as compared with 2,065 for the preceding year. This decline is no doubt attributable to the fact that a certificate is no longer required as a condition of entry in the Ministry's Register of Dairy Cattle. In addition to the 633 certificates issued for a year or part year record, certificates of merit were issued in

respect of 83 cows. These certificates are issued in respect of cows which have calved not less than three times during a period of three consecutive years and which have, during that period, yielded not less than the amount of milk prescribed for their breeds. Of the 83 cows which were so certified during the year ended 1st October, 1924, 28 (including 19 Shorthorns, 4 Friesian, 2 Red Poll) yielded over 30,000 lb. during the three years. The highest yield, viz., 49,337 lb. was given by a non-pedigree Shorthorn cow. A second non-pedigree Shorthorn gave 38,508 lb. and a Red Poll cow gave 38,000¼ lb.

Calf and Bull Marking.—This useful auxiliary to the practice of milk recording is becoming more popular. All the societies have now adopted the scheme laid down by the Ministry, and during the year under review 14,248 calves and 114 bulls were marked. A prominent breed society now insists that their members who are " grading up " shall have their calves marked by their milk recording society.

Rationing.—The importance of proper rationing as a factor in the profitable production of meat and milk is gradually becoming more widely recognised, and the arrangements made by County Agricultural Organisers for providing assistance and advice to members of milk recording societies in this connection have been increasingly taken advantage of during the year.

Testing for Butter-fat.—While the practice continues in this country of selling milk by bulk and not by quality, the question of butter-fat content will naturally receive less attention than is desirable. Although compulsory testing for butter-fat is not a practicable proposition under the Ministry's Scheme, provision has been made for voluntary testing where desired by either the society or the member. Interest in this aspect of milk production is increasing, and the steps which have been taken in recent years to encourage the production of clean milk will no doubt assist in focussing the attention of farmers on the need for quality as well as of quantity in milk yields.

During the year ended 1st October, 1924, nearly 72,000 samples were taken and analysed, and over three-quarters of these samples were from the milk of individual cows.

Cost of Milk Recording.—There was a slight drop in the cost of recording during the year, both as regards the average cost per cow to the member and to the Society, which for the year ended 1st October, 1924, was 4s. 5d. and 6s. 4½d. respectively. While these costs cannot be said to be excessive, in view of the solid advantages now proved to be obtained by milk recording, it is desirable, from the point of view of inducing new members

to join societies, that the cost should be kept as low as possible. It is satisfactory, therefore, that the tendency is in the right direction, and with the more efficient working of societies, which has been an encouraging feature of the year under review, there is reason to hope that in due course it will be possible for any society to operate at a maximum average cost to the member of not more than five shillings per cow. In several cases, at present, where exceptional conditions exist, the cost to the member is much less than this.

Export of Live Stock to Colonies and Foreign Countries.—It is, of course, generally known among exporters of live stock and other products, such as hay, straw, hides, etc., from this country, that most foreign and colonial governments have made regulations governing the importation of live stock with the object of preventing the introduction of diseases. In many cases these regulations require that animals imported from Great Britain shall, *inter alia*, be accompanied by a certificate from the Ministry as to freedom from certain diseases of the districts from which the animals come. The Ministry has, for some years, undertaken the issue of certificates where required, upon application by the intending exporter giving the necessary particulars. In many cases the regulations also require a certificate of health of the animals concerned to be given by a recognised veterinary surgeon. Intending exporters can obtain information from the Ministry with regard to the requirements of any particular foreign or colonial regulations and, in this connection, it may perhaps be mentioned that, in order to avoid delay and expense, every care should be taken by exporters to make application as early as possible before the date of intended shipment, and to comply with the strict letter of the regulations, *e.g.*, in the wording of veterinary certificates.

Particulars of the number and declared value of animals exported to colonies and foreign countries are now published quarterly in this *Journal*. (See p. 568 of this issue.)

The following are the principal memoranda used in connection with the live stock operations of the Ministry, and single copies of them can be obtained free of charge on application to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1 :—

Leaflet 282. Scheme for Improvement of Live Stock.
Leaflet 146. The Value of Records of the Milk Yields of Cows.
No. 609/T.L. Bull Grant Regulations.
No. 392/T.L. Milk Recording Regulations.
No. 466/T.L. Boar Grant Regulations.
No. 89/T.L. Heavy Horse Regulations.

Statement giving Particulars of 52 Milk Recording Societies operating during the year ended 1st October, 1924.

(The Societies are arranged in order of total number of animals recorded.)

ociety.	*No. of Members.	*No. of Herds.	*Total No. of animals recorded.	*No. of Cows recorded for full year.	Average yield of cows recorded for full year.
Essex	230	254	8,940	4,853	7306.1
Somerset and North Dorset	242	283	8,460	4,868	6958.1
Hampshire	204	225	7,339	3,670	6959.1
East Sussex	200	241	7,067	3,862	6958.4
Berkshire	146	167	5,958	3,149	6959.7
Kent	182	211	5,639	2,981	7022.4
Hertford	169	189	5,607	3,008	7034.7
North-West Wilts ...	112	130	5,429	2,743	7109.7
Norfolk	180	202	4,948	2,738	7400.9
Dorset	82	106	4,865	3,168	6592.8
Surrey	174	184	4,728	2,446	6704.5
West Sussex	118	134	4,084	2,147	7054.2
Oxford...	103	112	3,738	1,936	7026.9
Warwick	135	142	3,539	1,638	7261.8
Lancashire	118	125	3,322	1,501	6695.3
Leicester	120	125	3,124	1,488	7211.5
Suffolk	135	147	3,121	1,901	7457.6
Salisbury	48	65	2,765	1,788	7664.1
Northants	98	111	2,415	1,197	6404.3
South Devon	107	112	2,358	973	6092.3
Yorkshire	133	138	2,261	1,133	7313.8
Shropshire	72	80	2,246	1,327	7223.7
Cambridge	84	92	2,228	1,234	7538.0
Cumberland and North Westmorland	131	135	2,050	973	5765.8
Stafford	79	85	2,030	1,084	7519.3
Derby	52	57	1,881	870	7524.8
Nottingham	54	58	1,868	773	7171.7
Bucks	66	70	1,845	999	7238.2
Cheshire	52	55	1,745	889	6903.3
Denbigh and Flint ...	84	86	1,664	851	6820.6
Bristol and Bath... ...	77	78	1,632	934	7412.2
Peak (Derby)	72	72	1,514	629	7226.0
Worcester	70	73	1,485	805	7375.3
East Devon	78	78	1,461	671	7053.6
Bedford	46	49	1,282	724	6941.6
Warminster and Mere ...	26	30	1,215	848	7286.3
Cornwall	59	60	981	541	6233.5
Kendal and S. Westmorland	49	50	971	398	5951.9
Lincoln	38	40	950	452	6956.2
Cotswold	43	43	947	610	7579.2
Tees Valley	28	36	920	444	7429.9
Anglesey and Carnarvon ...	84	85	896	526	5451.4
Herefordshire	35	35	842	427	7008.0
United Counties	59	60	819	425	6597.8
North Somerset	33	36	818	473	6977.8
Monmouth	34	36	764	344	6605.0
Campden Moreton ...	31	32	663	406	7002.6
Allendale	36	37	611	361	6833.9
Gloucester	29	30	599	338	7261.0
Melton Mowbray... ...	29	30	532	312	6740.1
Glamorgan	51	51	521	245	6776.2
Montgomery	23	23	399	237	6701.1
TOTALS	4,740*	5,185*	138,086*	73,338*	7030.1

* Goats are not included.

THE EFFECT OF LIGHT AND HEAVY DRESSINGS OF LIME ON GRASSLAND.

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IMPROVEMENT of grassland, both as regards yield and quality of herbage, is one of the great problems in agricultural practice. Increased yield and better quality represent greater stock-carrying capacity for a given area or, under favourable circumstances, more profit from the sale of hay, although a higher yield of hay does not necessarily entail increased financial gain. The judicious use of organic and artificial manures, and in certain cases the application of lime or chalk, do much towards bringing about the desired improvement, and much experimental work has been done in this connection. The action of lime, however, is apt to be so variable under different conditions that some recent results may prove of interest and value.

Experiments at Rothamsted.—In the course of long-continued experiments on grassland on heavy loam at Rothamsted the effect of similar and regular applications of lime has been found to vary according to the manurial treatment. A dressing of 2,000 lb. of lime per acre has been applied to one-half of each plot every four or five years since 1903, the other half remaining unlimed as a control. In the case of unmanured plots the lime has had very little constant effect upon the yield, but has altered the character of the herbage somewhat by increasing the proportion of grasses and leguminous plants and decreasing the miscellaneous plants or weeds. Furthermore, the proportion of such species as downy oat (*Avena pubescens*), quaking grass (*Briza media*) and meadow pea (*Lathyrus pratensis*) has increased, whereas bent grass (*Agrostis vulgaris*) sweet vernal (*Anthoxanthum odoratum*) and hawkbit (*Leontodon hispidus*) have been considerably decreased by liming. With complete mineral manures (including phosphate, potash, soda and magnesia), both with and without the addition of ammonium sulphate, liming has brought about a larger yield in every case, and has also radically altered the character and composition of the herbage, especially where nitrogen has been applied. Meadow foxtail (*Alopecurus pratensis*) shows a most striking response to lime with heavy manuring, the proportion increasing from 2 per cent. to 76 per cent. in some years, whereas Yorkshire fog (*Holcus lanatus*) and sweet vernal grass show a similar but less marked decrease in the presence of lime. Meadow pea, downy oat and smooth-stalked meadow grass

(*Poa pratensis*) are all usually favoured by liming, whereas bent grass, plantain (*Plantago lanceolata*), sorrel (*Rumex Acetosa*) and pignut (*Conopodium denudatum*) are generally reduced thereby.

Under these manurial conditions, therefore, liming on this particular soil has been beneficial both as regards yield and the quality of the resulting herbage, but under other conditions a different state of affairs occurs. Where nitrate of soda or mineral manures without potash have been applied liming has proved disadvantageous and has reduced the yield, the same effect being observed with organic manures, such as farmyard manure and fish guano. This rather unexpected result with the fairly heavy dressing of 2,000 lb. of lime per acre led to a further investigation to determine whether different dressings of lime would vary in their effect upon the crop, and whether lighter applications would improve, instead of reduce, the yield.

Three plots of known manurial treatment, hitherto unlimed, were selected in 1920, and the lime requirement of each was determined by two distinct methods. One of these (the Hutchinson Maclennan method) indicated the quantity for a heavy dressing, whereas the second (a colorimetric method, based on the hydrogen ion concentration of the soil) gave the figure for a light application. The plots were then subdivided, one portion remaining unlimed as a control, the other two receiving light and heavy dressings of lime respectively. Owing to the very different lime requirement of the plots, due to the varied manurial treatment, the actual amount of lime required for a light dressing in some cases (see C in table, p. 506) was considerably greater than that needed for a heavy dressing on the other two plots. For the sake of convenience, however, the term "light liming" is used throughout to denote the smaller dressing in each case, and "heavy liming" for the larger dressing.

The lime was applied in the winter of 1919-20 and again in 1923-24. Every year since, at the time of cutting, the yields from each portion have been kept separate and representative samples of the grass have been taken, dried carefully to preserve their colour, and separated into their constituent species to determine the progressive effect of liming upon the composition of the herbage. On these experimental plots it is usual to cut a second crop in autumn unless the growth of the aftermath is too poor to justify this procedure. No grazing is ever carried

out on the area, as the introduction of organic manure by sheep or cattle and the trampling of their feet would introduce factors which would render it difficult to determine the actual effect of the experimental manures and lime applied. In considering the following results, however, most importance must be attached to the figures of the first crop, as they represent the greatest value to the farmer, while the quality of the first crop hay is distinctly better than that of the aftermath.

The manuring and liming of the plots were as follows:—

Manuring. (*1905 & since*).	*Light liming.* lb. per acre *applied 1920 & 1924.*	*Heavy liming.* lb. per acre *applied 1920 & 1924*
A. Dung every fourth year (14 tons per acre	570	3,150
B. Dung every fourth year (14 tons per acre), nitrate of soda and mineral manures in intervening years (e.g. dung 1905, artificials 1906, 1907, 1908) ...	570	2,772
C. Sulphate of ammonia, potash, magnesia and sulphate of soda every year	3,951	6,788

The lime requirements of the two plots receiving dung were very similar, enabling a close comparison to be made, and this rendered the difference in the action of the lime, as described below, all the more striking.

(A) **Dung Only.**—The lime was put on in the fourth year of the course, when the plot had received no dung for three seasons, and in the first year after application the yields with and without lime were very similar, the differences probably being within experimental error. With the application of dung in the next year, however, the liming appeared to work most disadvantageously, as the crop fell heavily with both dressings and continued at this low level till more lime was applied in 1924, when all the yields were again much alike. In 1922 the aftermath was also much lower on the limed plots, but in other years there was little difference. In Table I the yields for the four years' course after the first liming are bulked together, and that for the one available year after the second liming is shown separately:—

TABLE I.

	Total Yield 1920-23. cwt. per acre. *1st crop.*	*2nd crop.*	*Yield 1924.* cwt. per acre. *1st crop only.*
Unlimed	111.94	73.23	25.29
Light lime	92.65	61.93	24.21
Heavy lime	85.78	68.78	27.43

No very marked or constant change in the composition of the herbage was observed, except for a distinct reduction in the quantity of sweet vernal grass (as from 11.5 to 1.4 per cent.) with heavy liming, and some reduction of tall oat grass (*Arrhenatherum avenaceum*) (as from 8.5 to 1.9 per cent.) with light liming. It was noticeable that this latter reduction was much less marked with the heavy liming.

The reduced yield brought about by liming on areas receiving organic manure alone is also shown by another plot which is treated with dung and fish guano alternately every second year, with lime at the rate of 2,000 lb. per acre every four or five years. In this case the liming has been carried on for a longer period, since 1903, and its harmful effects were possibly increased thereby. Here again the application of lime in years when no organic manure was used (*i.e.*, 1920, 1924) temporarily levelled up the yields, but in the other three years a marked drop occurred, as shown in Table II.

TABLE II.

Applied.	1st crop (per acre). *Limed.* cwt.	*Unlimed.* cwt.	2nd crop (per acre). *Limed.* cwt.	*Unlimed.* cwt.
1919 Fish guano	35.07	44.98	14.87	15.93
1920 Lime	34.17	34.03	11.60	14.36
1921 Dung	34.28	37.55	—	—
1922 —	26.68	41.54*	18.46	23.08
1923 Fish guano	47.51	60.56	29.04	29.19
1924 Lime	38.10	49.19	—	—

The application of lime to land receiving dung or other organic manures alone, at least on heavy soils of this nature, seems therefore to be attended with considerable danger of crop reduction instead of improvement, and great care should be exercised before such a procedure is followed. The reason for the detrimental action is not clear, and it would be interesting to know whether similar results follow from the application of dung and lime on other types of soil, especially on those that are initially in greater need of liming than the Rothamsted loam.

(B) **Dung and Artificial Manure.**—The application of artificials, including nitrate of soda and minerals, to dunged grassland completely changed the effect of lime upon the area. Immediately after the first application the light dressing considerably improved the crop, this increase was maintained year after year, and after the second application of lime in 1924 the yield of the first crop was a ton per acre higher than that

* A shower of rain fell while this plot was being loaded on to the cart so that the weight was rather heavier than it ought to have been.

of the untreated plot and the grass was totally different in character, being dense and very dark green, in sharp contrast to the thinner stand of light green grass with no lime. With light liming, however, the second crop was always somewhat below that of the other two plots, though the difference was not usually great.

The heavy dressing, on the contrary, did not have the marked beneficial effect. The first crop was usually, but not always, slightly above that on the untreated plot, but its total increase due to heavy liming was only 10 cwt. over the whole period of five years, and the grass was light green and very similar to that on the untreated area. The yields were as follows :—

TABLE III.

	Total yields 1920-23. cwt. per acre.		*Yield 1924.* cwt. per acre.
	1st crop.	*2nd crop.*	*1st crop only.*
Unlimed... ...	128.16	66.75	31.71
Light lime ...	151.67	53.46	51.08
Heavy lime ...	134.09	62.30	35.79

Rather unexpectedly the great improvement in the character of the herbage with light liming was not associated with any striking change in its composition, being due rather to a general all-round improvement in the habit and growth of most of the species present. Although heavy liming did not cause a corresponding improvement in growth, it had more effect upon a few individual species, causing a reduction in bent grass (*Agrostis vulgaris*) (as from 15 to 4.2 per cent.) and tall oat grass (*Arrhenatherum avenaceum*) (as from 6 to 0.4 per cent.), and some increase in downy oat (*Avena pubescens*) (as from 5.3 to 10.4 per cent.) and meadow foxtail (*Alopecurus pratensis*) (as from 16 to 20.9 per cent.).

In this case therefore, the rate of application of the lime was of vital importance, for whereas a moderate dressing at a reasonable cost brought about a considerable increase in yield and a decided improvement in the herbage, a heavy dressing at a much greater cost failed to produce any appreciable rise in yield and had much less beneficial effect upon the grass. The result suggests that on land that is well manured with dung supplemented with artificials, a light dressing of lime may prove a remunerative investment, though the usual heavier application would be of little or no use, resulting actually in financial loss.

(C) **Artificial Manure without Phosphate.**—This combination of manures is exceptional, as it is very rarely used in practical farming, but it was selected in order to ascertain what happens when grassland receiving lime is deficient in phosphate. With

this type of manuring lime had more effect upon the distribution of growth throughout the year than upon the total yield. Both light and heavy dressings of lime appreciably raised the yield of the first crops, but this was set off by a corresponding decrease in the second crops, the total yields being very similar on the untreated and limed plots over the whole period of experiment. In the first years after the application of lime the light dressing appeared to be more beneficial, but this superiority over the heavy dressing was not maintained and the total first crops in both cases were much the same over the four year course.

TABLE IV.

	Total yield 1920-23. cwt. per acre.		*Yield 1924.* cwt. per acre.
	1st crop.	*2nd crop.*	*1st crop only.*
Unlimed... ...	94.13	86.73	28.02
Light lime ...	120.85	51.03	32.46
Heavy lime ...	124.56	59.19	29.52

The heavier first crops with liming followed by decreased second crops may indicate that under these manurial conditions growth is considerably hastened by the application of lime, resulting in a heavier bulk of grass at the time of the first cutting, but leaving the herbage less able to produce a heavy aftermath. Without lime less growth is made at first, but the grass is able to carry on more vigorously after the first cut, yielding a much heavier aftermath which more than compensates in bulk for the lower first crop, though from the point of view of the farmer the heavier first crop with lime is probably of more value than the correspondingly heavier aftermath in its absence.

Although, on balance, liming had so little effect on the total yield, it brought about some improvement in the quality of the herbage, in that both light and heavy dressings reduced the percentage of the rather undesirable bent grass (*Agrostis vulgaris*) (as from 72 to 26 per cent.) and increased the amounts of the more useful foxtail (*Alopecurus pratensis*) (as from 14.6 to 22.6 per cent.) and tall oat grass (*Arrhenatherum avenaceum*) (as from 0.3 to 10 per cent.). One curious and rather unexpected development was that sorrel (*Rumex Acetosa*) was in this case increased by liming (as from 2.2 to 9.7 per cent.). Sorrel is usually considered to indicate some degree of soil acidity and to be decreased by the application of lime which reduces this acidity. It seems doubtful, however, whether sorrel should be regarded as a true indicator in this way, as other factors than acidity appear to affect its prevalence. Possibly, in this case, the absence of phosphate from an otherwise complete fertiliser may have had something to do with

its increase in the presence of lime. More information is necessary, however, before this point can be settled.

This particular experiment illustrates a case in which similar results were obtained with both light and heavy dressings of lime, the extra money spent on the heavier dressing being therefore wasted. Also, where first crop hay is the desideratum, it indicates how liming may aid towards an increased crop, though this may be at the expense of the aftermath.

Profit or Loss due to Liming.—As a general rule the mere attainment of increased yields by means of liming is of little use to a farmer unless the value of the increase more than compensates for the cost of the lime and its application. Certainly under some circumstances, in cases where the herbage is originally of a very poor type, the improvement in quality may more than balance a failure to obtain increase in crop or even a slight actual loss in crop, but these instances are likely to be the exception rather than the rule. For the sake of demonstration a costings table has been drawn up for the experiments described above. The cost of lime has been reckoned as 30s. per ton, and the cost of spreading has not been included. The value of the first crop has been taken at 90s. per ton, and of the second crop at 75s. per ton, both being average market prices for hay of the quality obtained. In Table V the increases and decreases in crops and the monetary values of the same are reckoned in comparison with unlimed areas in each case :—

TABLE V.—ESTIMATED PROFIT OR LOSS PER ACRE DUE TO LIMING. (1ST AND 2ND CROP.)

Liming.	Increase (+) or decrease (—)		Value of increase (+) or decrease (—).			Cost of Lime.	Estimated Net profit (+) or loss (—) over 4 years.	Ave profi (loss per
	1st crop. cwt.	*2nd crop.* cwt.	*1st crop.* £ s. d.	*2nd crop.* £ s. d.	*Total.* £ s. d.	£ s. d.	£ s. d.	£
	A.	*Dung only.*						
Light	—19.29	—11.30	—4 6 10	—2 2 5	—6 9 3	7 8	—6 16 11	—1
Heavy	—26.16	—4.45	—5 17 8	—16 8	—6 14 4	2 2 2	—8 16 6	—2
	B.	*Dung and Artificials.*						
Light	+23.51	—13.29	+5 5 10	—2 9 10	+2 16 0	7 8	+2 8 4	+
Heavy	+5.93	—4.45	+1 6 8	—16 8	+10 0	1 17 2	—1 7 2	-
	C.	*Artificials without Phosphate.*						
Light	+26.72	—35.70	+6 0 3	—6 13 10	—13 7	2 12 11	—3 6 6	—
Heavy	+30.43	—27.54	+6 16 11	—5 3 3	+1 13 8	4 10 11	—2 17 3	—

A consideration of the above table shows that in only one case was there a net profit per acre when both first and second crops were considered, a light dressing of lime with dung and artificial manures showing a profit of 12s. 1d. per acre. In every other instance a loss was experienced, from 14s. 4d. per acre with artificials and lime to as much as £2 4s. 1½d. per acre when a heavy dressing of lime was used in conjuction with dung. This net loss is in most cases due to the fact that the second crops are less heavy on the limed than on the unlimed areas. and to the heavy cost of liming per acre, as the loss on these two items more than counterbalances the gain on the first crop due to liming. As a matter of fact, the second crop would not be cut in ordinary farm practice, and it is difficult to estimate the value of the aftermath when grazed off instead of being allowed to grow on for cutting. The difference in treatment might bring about an entire alteration in the value of the second crop. This being the case, it may be of interest to see the value of liming with regard to the first crop only, as this would usually provide the criterion whereby a farmer would judge whether the treatment had justified itself or not:—

TABLE VI.—ESTIMATED PROFIT OR LOSS PER ACRE DUE TO LIMING. (1ST CROP ONLY.)

Liming.	*Value of increase (+) or decrease (—) of 1st crop.* £ s. d.	*Cost of Lime.* £ s. d.	*Net profit (+) or loss (—) over 4 years.* £ s. d.	*Average profit (+) or loss (—) per annum.* £ s. d.
	A. Dung only.			
Light	—4 6 10	7 8	—4 14 6	—1 3 7½
Heavy	—5 17 8	2 2 2	—7 19 10	—1 19 11½
	B. Dung and Artificials.			
Light	+5 5 10	7 8	+4 18 2	+1 4 6½
Heavy	+1 6 8	1 17 2	—10 6	—2 7½
	C. Artificials without Phosphate.			
Light	+6 0 3	2 12 11	+3 7 4	+16 10
Heavy	+6 16 11	4 10 11	+2 6 0	+11 6

From this point of view liming was a more profitable proposition except where dung alone was used. With this the loss per annum was still very considerable, just £2 per acre with heavy liming, and more than half as much with the light dressing. With dung and artificials, however, the profit per acre with the light dressing was twice as much as when the second crop was considered, and the loss with the heavy dressing was reduced to 2s. 7½d. In both these cases the order of events was the same whether one or both crops were taken into account, though the actual amount of the profit or loss was altered. With artificials only, on the contrary, the loss

incurred with the two crops became a corresponding profit where the first crop only was concerned, owing to the alteration in the season of greatest growth caused by the lime. It is thus shown by these tables that in estimating the value or otherwise of various dressings of lime, other factors than that of actual increase in yield of the hay crop have to be taken into account, including the cost of the lime itself and the importance of the aftermath in the economics of the farm.

Summary.—The results obtained may be briefly summarised as follows:—

(1) With dung only the use of lime in heavy or light dressings caused a reduction in yield both of first and second crops, and no very marked change in the composition of the herbage was observed except with sweet vernal grass and tall oat grass.

(2) With dung and artificials a light dressing of lime brought about a substantial increase in the first crop, which far more than counterbalanced a certain decrease in the aftermath. The character of the herbage was greatly improved, but more by the generally enhanced growth of most species of plants, than by the special encouragement of a few species only at the expense of the others. Heavy liming did not cause the marked increase in the first crop nor so much reduction in the second. Furthermore, though little improvement in growth appeared, bent grass and tall oat grass were considerably reduced, and downy oat grass and meadow foxtail increased in proportion in the herbage.

(3) With artificials without phosphate the total yields were not much affected, but growth was earlier with both light and heavy liming, resulting in an increased first crop and decreased second crop. Liming brought about some improvement in the herbage by reducing bent grass and increasing foxtail and tall oat grass.

(4) The profit or loss due to liming has been calculated, showing a heavy loss where lime was used in conjunction with dung alone, but a moderate profit when a light dressing of lime was given with dung and artificial manures.

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A SIMPLE GUIDE TO THE PURCHASE OF FEEDING STUFFS.

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THE selective purchase of concentrated feeding stuffs is, for the farmer, a constantly recurring problem. Various methods of procedure are found in practice. A few farmers still adhere to a traditional formula and confine their purchases to such well-known favourites as linseed cake and cotton cake. Others, having become convinced of the special value of one particular cake or meal, stick to it regardless of price variation: for example, yellow meal may be the *sine qua non* in one case or in one district, and bean meal in another.

There are also a number of farmers who adopt the principle that all purchases of concentrated foods should be avoided. In those cases where the home-grown foods include such a variety of crops as beans, peas and linseed, as well as cereals, this attitude has much to commend it, but where home-grown concentrates comprise only cereals, adequate production rations are then unattainable without recourse to outside supplies.

Although these methods of providing the required concentrates for stock purposes are fairly common, the majority of farmers deal with the question from a more flexible angle. In some cases it is found advisable to supplement a varying quantity and quality of home-grown foods with purchased concentrates; while in others it may be necessary to purchase all the production part of the rations.

There also arise such questions as which of the home-grown foods should be fed and which sold, and which concentrates make the most suitable purchases. These points of view recognise two simple facts: (1) that the choice of feeding stuffs depends on circumstances as well as prices, and (2) that there is a great variety of concentrated foods to choose from.

The question arises therefore, "On what plan, if any, is the selection made from the very extensive range of products on the market?" It must be admitted at once that very often the purchaser simply depends on his own shrewdness and experience, though necessarily this must greatly limit his choice, as few have had experience of more than a few of the possible feeding stuffs which are available.

Sometimes advice is given by merchants and dealers, and where these are the representatives of reliable firms, the advice is usually sound and readily taken. The salesman may strongly recommend a certain food on the grounds that, at the time, it is relatively cheap. In this way also the farmer may be induced to try something new, while compound foods are frequently sold after this fashion.

Alternatively, the farmer may proceed in the most business-like manner by studying price lists and writing for quotations from various firms. Each week prices of feeding stuffs are published in the agricultural press. Since the introduction of uniform weights, these lists are of considerable use, but there still remains scope for great improvements in the method of their presentation. In the weekly market returns issued by the Ministry, comparative prices are set out in a systematic manner. A comparison of the unit prices which are given for each food enables the reader to see at a glance which foods are relatively expensive, and which are cheap, and a summary of this information is usually published in the agricultural press.

In practice, however, a difficulty arises in making use of these figures—published market prices, f.o.r. London or other port, or ex store, do little more than indicate the trend of prices; they cannot be translated into actual costs at the nearest station or on the farm, and they may in some instances differ considerably from the prices of the same foods or alternative foods from a local source.

It must therefore be very disconcerting to find after the most careful study of the *published* figures, that these differ from *local* prices, and that the variation is not a uniform one up or down, but actually alters the order of relative values. This frequently happens in practice, and brings the farmer back to the original position—that he must exercise his own shrewdness or set to work with paper and pencil to make fresh calculations of unit prices. It is an unfortunate position, most discouraging to those who are only too anxious to proceed in the most businesslike manner.

This short article has therefore been written in order to present a simple table which can be permanently used under all circumstances as a reliable guide to the economical purchase of feeding stuffs.

The method employed in arriving at unit prices in the table is that used in the Monthly Notes on Feeding Stuffs (see Note at the foot of page 559 of this *Journal*). That this method is

not strictly accurate is admitted, but on the other hand it is the most reliable, simple method available. Long experience of its use confirms the soundness of the results obtained, and the writers have no hesitation in recommending the figures.

First it will be noticed that all the most commonly used foods have been arranged into a series of Groups. The foods in each group are similar in composition and one can be substituted for another in production rations. This arrangement is extremely useful, not only in connection with the purchase of foods, but also as a guide to the making up of production rations for dairy cows.

Use of the Table.—The method of using the table to indicate which are the cheapest foods is very simple : two examples only need be given :—

(1) A farmer wishes to replenish his supply of decorticated cotton cake. He knows that any of the foods in Group 2 will answer the same purpose, and he therefore invites quotations from various firms for all the foods mentioned in this group.

He receives offers as follows, and using the table reads off the unit prices opposite each food below the prices quoted, thus :—

Food.	*Price quoted per ton.*	*Unit Prices from Table.*	*Unit Price.*
Cotton Seed Meal ...	£11 5 0	2/2 plus $\frac{3}{4}$	2/2$\frac{3}{4}$
Decorticated Cotton Cake	£13 0 0	2/11	2/11
Soya Bean Cake ...	£10 15 0	2/1 " 2$\frac{1}{2}$	2/3$\frac{1}{2}$
Decorticated Ground Nut Cake	£11 15 0	2/2 " 2$\frac{1}{2}$	2/4$\frac{1}{2}$
Undecorticated Ground Nut Cake	£10 0 0	2/10	2/10
Sesame Cake	£11 0 0	2/2	2/2

It is immediately seen that the difference in value between cotton seed meal and sesame cake is negligible, and that either or both of these might be used, also that the foods in order of cheapness are—sesame cake, cotton seed meal, soya bean cake, decorticated ground nut cake, undecorticated ground nut cake and decorticated cotton cake.

(2) A farmer finds his supply of oats will shortly be exhausted. This food he knows can be replaced by one or more of those given in Groups V and VI.

His quotations are as follows:—

Food.	*Price quoted per ton.* £ s. d.	*Unit Price from Table.* s. d.	d.	*Unit Price.* s. d.
Oats...	10 0 0	3 1	—	3 1
Wheat	12 0 0	3 1	—	3 1
Maize Germ Meal ...	9 10 0	1 11 plus	1½	2 0½
Maize	10 10 0	2 3 „	1½	2 4½
Rice Meal	8 5 0	2 0 „	¾	2 0¾
Barley Meal ...	10 15 0	2 7 „	2½	2 9½

Clearly a purchase of either oats or wheat at the prices quoted would be very uneconomical. Maize germ meal is the cheapest direct substitute, or a suitable combination of maize germ meal and rice meal might be used.

The facilities which the Table provides for comparing relative values of foods may be turned to another use, namely, to indicate whether home-grown foods should be sold or fed. This may be illustrated from the above figures for foods from Groups V and VI. Oats, which can be sold at £10 per ton, are relatively expensive for feeding. Owing, however, to their special value for horses and calves, sufficient for these purposes might be retained and the remainder sold. If the price of oats should rise and other prices remained the same, the incentive to sell would be correspondingly increased.

Barley meal at £10 15s. per ton is reasonably near in value to other foods, but when barley meal recently cost up to £14 per ton or 3s. 9d. per unit, it was clearly very easy to find cheaper substitutes. Even pig feeders in such circumstances were tempted to omit barley from their rations or to reduce greatly the quantity fed.

Lastly, wheat at £12 per ton is relatively expensive, and would usually be sold off the farm even if this necessitated the purchase of other food stuffs.

Limitations of the Table.—The special value of the Table lies in the fact that it can be used continuously as a guide to the relative feeding values of foods whether purchased or home grown. Posted up in an office it should always prove of service. It is well, however, to emphasise the fact that a system of this kind can act as a guide only for the following two main reasons:—

(1) The figures are necessarily based on the *average* compositions of the feeding stuffs mentioned. Most of the foods, however, do not vary greatly from the average.

(2) A knowledge of the specific properties of feeding stuffs is essential for their proper use.

Unit Prices of Feeding Stuffs at different Costs per Ton.

Feeding Stuffs.	Starch Equivalent.	Unit Price at the following Costs per Ton.														
		£5	£6	£7	£8	£9	£10	£11	£12	£13	£14	£15	5s.	10s.	15s.	20s.
		s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	d.	d.	d.	d.
Group II. *Very Rich in Protein—*																
Cotton Seed Meal	74	7	10	1 1	1 4	1 7	1 11	2 2	2 5	2 8	3 0	3 3	¾	1½	2½	3¼
Decorticated Cotton Cake ...	70	7	11	1 2	1 6	1 9	2 0	2 4	2 7	2 11	3 2	3 5	¾	1½	2½	3¼
Soya Bean Cake	69	7	11	1 2	1 6	1 9	2 1	2 5	2 8	3 0	3 3	3 6	¾	1½	2½	3¼
Decorticated Ground Nut Cake	73	6	10	1 1	1 4	1 8	1 11	2 2	2 5	2 9	3 0	3 3	¾	1½	2½	3¼
Undecort. Ground Nut Cake ...	57	1 1	1 5	1 9	2 1	2 6	2 10	3 2	3 6	3 11	4 3	4 7	1	2	3	4¼
Sesame Cake	73	7	10	1 1	1 4	1 8	1 11	2 2	2 6	2 9	3 0	3 3	¾	1½	2½	3½
Group III. *Rich in Protein—*																
Cotton Cake Bombay ...	40	1 8	2 2	2 8	3 2	3 8	4 2	4 8	5 2	5 8	6 2	6 8	1½	3	4½	6
Cotton Cake Egyptian ...	42	1 6	2 0	2 6	3 0	3 5	3 11	4 5	4 10	5 4	5 10	6 3	1½	3	4½	6
Linseed Cake	74	9	1 0	1 4	1 7	1 10	2 1	2 5	2 8	2 11	3 2	3 6	¾	1½	2½	3¼
Beans	67	1 0	1 4	1 7	1 11	2 2	2 6	2 9	3 1	3 5	3 8	4 0	¾	1½	2½	3½
Grain	71	1 0	1 4	1 7	1 10	2 2	2 5	2 9	3 0	3 3	3 7	3 10	¾	1½	2½	3¼
Peas	69	1 0	1 3	1 7	1 11	2 2	2 5	2 9	3 0	3 4	3 7	3 11	¾	1½	2½	3½
Maize Gluten Feed	75	1 0	1 3	1 6	1 9	2 0	2 4	2 7	2 10	3 1	3 4	3 8	¾	1½	2½	3¼
Group IV. *"Balanced" Foods—*																
Malt Culms...	41	1 7	2 1	2 6	3 0	3 6	4 0	4 6	5 0	5 6	6 0	6 5	1½	3	4½	6
Brewers' Grains Dry	48	1 7	2 0	2 5	2 10	3 3	3 8	4 1	4 6	4 11	5 4	5 9	1	2½	3½	5
Palm Kernel Cake (6% Oil) ...	75	1 0	1 4	1 7	1 10	2 1	2 4	2 7	2 11	3 2	3 5	3 8	¾	1½	2½	3¼
Palm Kernel Cake Extracted ...	71	1 1	1 5	1 8	1 11	2 3	2 6	2 9	3 1	3 4	3 8	3 11	¾	1½	2½	3¼
Coconut Cake	79	1 0	1 2	1 5	1 8	1 11	2 2	2 5	2 8	2 11	3 2	3 5	¾	1½	2½	3
Wheat Offals—																
Fine Middlings	72	1 1	1 4	1 8	1 11	2 3	2 6	2 9	3 0	3 4	3 7	3 11	¾	1½	2½	3¼
Coarse Middlings ...	64	1 3	1 6	1 10	2 2	2 5	2 9	3 1	3 5	3 8	4 0	4 4	1	2	3	3¾
Pollards	60	1 4	1 8	2 0	2 4	2 8	3 0	3 4	3 8	4 0	4 4	4 8	1	2	3	4
Bean	45	1 7	2 1	2 6	3 0	3 5	3 10	4 3	4 9	5 2	5 7	6 1	1¼	2½	4	5¼
Linseed (whole)	120	7	9	11	1 1	1 3	1 5	1 7	1 9	1 11	2 1	2 3	½	1	1½	2
Group V. *Starchy Foods—*																
Oats	60	1 5	1 9	2 1	2 5	2 9	3 1	3 5	3 9	4 1	4 5	4 9	1	2	3	4
Wheat	71	1 2	1 5	1 9	2 0	2 3	2 7	2 10	3 1	3 5	3 8	4 0	¾	1½	2½	3¼
Rye	71	1 2	1 5	1 9	2 0	2 3	2 7	2 10	3 1	3 5	3 8	4 0	¾	1½	2½	3¼
Maize Germ Meal	85	11	1 2	1 5	1 8	1 11	2 2	2 5	2 7	2 10	3 1	3 4	¾	1½	2¼	2¾
Group VI. *Very Starchy Foods—*																
Maize	81	1 0	1 3	1 6	1 9	2 0	2 3	2 6	2 9	3 0	3 3	3 6	¾	1½	2¼	3
Rice Meal	72	1 2	1 5	1 9	2 0	2 3	2 6	2 10	3 1	3 4	3 8	3 11	¾	1½	2½	3¼
Barley	71	1 2	1 6	1 9	2 0	2 4	2 7	2 11	3 2	3 5	3 9	4 0	¾	1½	2½	3¼

ERADICATION OF SHEEP SCAB.

THE Minister has had under consideration representations which have been made to the Department to the effect that the existing regulations relating to sheep scab are prejudicial to the sheep trade and inconsistent with the actual position with regard to sheep scab in certain parts of Great Britain. The representations referred to have been directed particularly against the regulations made by many Local Authorities requiring the double dipping of sheep moved into their districts from other counties, and it has been urged that the powers of Local Authorities to make such regulations should be withdrawn and that the necessary measures for dealing with sheep scab should be imposed by the Ministry alone.

The Minister is anxious that in dealing with this disease the minimum of restrictions should be placed upon the sheep trade. At the same time he is faced with a demand from agriculturists for a policy aimed at the eradication of scab. It has, therefore, been necessary in considering this matter to arrive at a plan to achieve eradication but involving the minimum of restriction on the sheep trade.

It will be useful in this connection to review the main lines of the already existing policy. These are as follows:—

(a) *Infected Premises.*—The Sheep Scab Order of 1920 requires that where sheep scab is declared to exist, all affected sheep on the premises shall be kept separate and dipped as often as may be necessary until cured, but at least twice with an interval of not less than 7 and not more than 14 days between the two dippings. Other sheep on the same premises and sheep moved elsewhere which on enquiry are ascertained to have been exposed to infection, are detained by notice until they have been double dipped.

(b) *Infected Areas.*—The Sheep (Double Dipping) Order of 1920 is applied by the Ministry to areas where sheep scab is prevalent or is suspected to exist unreported, the Local Authority being consulted with a view to the application of the Order to a suitable area. The effect of this Order is briefly:—

(i) to prohibit movement of sheep, other than sheep for immediate slaughter, out of any such area unless double dipped within the previous twenty-eight days, and/or

(ii) to require the double dipping with an interval of not less than seven and not more than fourteen days between the dippings, of all sheep in the area during a specified period which is fixed after consultation with the Local Authority.

(c) *Local Regulations.*—Article 12 of the Sheep Scab Order of 1920, as amended by the Sheep Scab (Amendment) Order of 1923, empowers Local Authorities to make regulations requiring the dipping of sheep within, or moved into, their districts, and many Local Authorities have exercised these powers.

(d) The Sheep Scab Order of 1923 requires sheep owners to take such steps as are reasonably practicable to secure that their sheep are free from scab. It provides that occupiers of farms or holdings upon which sheep are kept and owners of sheep kept on common land shall be liable, in case of failure to take such steps, to the penalties prescribed by the Diseases of Animals Acts.

It will be observed from headings (a) and (b) that sheep scab is at the present time dealt with on the premises and in the areas where it occurs. In view, however, of the difficulties of detecting scab in its earliest stages and the widespread distribution of the disease, these measures (a) and (b) alone, would not be sufficient to check the spread of the disease by the movements of sheep from one part of the country to another if the protective regulations of the Local Authorities were withdrawn. If, therefore, these local protective regulations are to be dispensed with, effective measures must be devised to take their place.

New Proposals.—This is the purpose of new proposals which have been drawn up by the Ministry and embodied in a draft Order which, together with an explanatory memorandum, has been forwarded to representative bodies concerned in order that the latter may have an opportunity of expressing their views on the proposals before they are brought into operation. A copy of the memorandum is given below.

The basis of these proposals is the general compulsory double dipping of all sheep in the country, accompanied by movement restrictions, limited to a comparatively short period of each year (15th July to 31st August), the remainder of the year being free from restrictions or from the requirement of dipping on movement. The Minister is advised that double dipping thoroughly performed with an interval of not less than 10 and not more than 14 days between the two dippings, must constitute the essential feature of any eradication plan, and that the most hopeful prospects of success will lie in effecting a general thorough double dipping of all sheep at one and the

same time throughout the country under conditions which will ensure that the beneficial effect of such dipping in one district will not be neutralised by subsequent contact of dipped sheep with sheep which have not been similarly treated. In the new plan, however, it has been considered necessary to provide for the exemption of whole counties which have been free from scab for the preceding two years, subject to proper conditions which will safeguard such counties against the risks of the re-introduction of the disease.

The provisions of the draft Order are not intended to supersede the present action with respect to Infected Places and Areas under the Sheep Scab Order of 1920 and the Sheep (Double Dipping) Order of 1920, but the withdrawal of the powers of Local Authorities to make their own regulations and the revocation of the Sheep Scab Order of 1923 will constitute a necessary part of the new scheme.

The Minister feels that it should rest with those concerned in the sheep industry to decide whether they will accept the measures considered to be necessary for the eradication of sheep scab or whether they will be content with merely controlling the spread of the disease.

It cannot be made too clear, however, that the most carefully devised measures will fail to achieve their object unless all concerned are prepared loyally to abide by the decision ultimately arrived at, and will co-operate actively to ensure that the regulations imposed are efficiently carried out. This will certainly mean a greater expenditure of time and money in the future in connection with the provision of proper dipping appliances, the careful mixing of the dipping bath in accordance with directions, the thorough dipping of each sheep, the cleansing of the bath and dipping places, and the separation of dipped from undipped sheep, etc. The observance of these matters should ensure the eradication of scab within a period of three or four years, but failure in any of these respects will jeopardise the success of the scheme and either prolong the period of its operation indefinitely or necessitate the abandonment of eradication in favour of control.

MEMORANDUM EXPLAINING PROPOSED SHEEP (GENERAL DOUBLE DIPPING) ORDER.

The draft Order proposes to put into operation a plan for the eradication of scab, involving dipping requirements and movement restrictions limited to a comparatively short period of the year (15th July—31st August), the remainder of the year being free from restriction or from the requirement of dipping on movement.

Special measures will in addition as at present be applied by the Ministry to the worst infected areas, and the Sheep Scab Order of 1920 with certain amendments will continue to apply to the sheep concerned in individual outbreaks of scab.

The draft Order contains the following main requirements:—

(1) *Compulsory General Double Dipping.*—All sheep throughout Great Britain will be required to be double dipped during the period from the *15th July to 31st August* except in any county declared by the Ministry to be exempt on the ground that it has been free from scab for at least the two preceding years. It will be within the absolute discretion of the Minister to consider on its merits whether a county should be declared "exempt" in which an isolated outbreak of scab had occurred originating from outside sources. Special provisions described below will apply to exempted counties.

The prescribed double dipping will be a dipping twice with an interval of not less than ten and not more than fourteen days between the two dippings by a thorough immersion in an approved sheep dip. After sheep have been double dipped they must be kept separate from undipped sheep during the remainder of the dipping period.

(2) *Notice to be given of intended dippings.*—To enable the Local Authority to supervise the dippings as far as practicable, the owner or person in charge of any sheep will be required to give notice to the Local Authority of the intended dippings of his sheep. The first notice must state the total number of ewes, rams, lambs, and other sheep on the premises on the first day of the prescribed dipping period, *i.e.*, on the 15th July.

In view of the importance of making adequate provision for the supervision of dippings, Local Authorities will be invited to enlist the assistance of farmers on a voluntary basis, and, with this object, to consult established agricultural bodies in their districts as to the individuals who should be appointed as temporary inspectors of the Local Authority for this particular purpose.

(3) *Returns and Declarations of Dipping.*—The owner or person in charge of any sheep must send a return on a prescribed form to the Local Authority in respect of each lot of sheep dipped during the dipping period. Forms for this purpose must be obtained from the Local Authority. After the dipping period has expired, a declaration must be furnished to the Local Authority by the 10th September, on a prescribed form showing that all sheep on the premises have been duly double dipped.

In the case of any sheep which the owner has failed to dip in accordance with the Order, the Local Authority will be required, without prejudice to any legal proceedings, to serve a Notice on the owner prohibiting the movement of the sheep until they have been double dipped under supervision.

(4) *Restrictions on inter-county movements of sheep during the dipping period, 15th July to 31st August.*—In order to prevent evasion of dipping by movement of sheep from one district to another, and the mixing of dipped with undipped sheep, the following restrictions on movement from one county to another are imposed by the draft Order.

Sheep may only be moved from one county to another if accompanied by—

(*a*) a certificate of the Inspector of the Local Authority of the district from which they are moved showing that the sheep have

been double dipped under the supervision of an Inspector during the dipping period, or within twenty-eight days immediately preceding the movement, or

(*b*) a licence from an Inspector of the Local Authority of the district from which they are moved authorising movement to a slaughterhouse. In the latter case the sheep must be marked on both sides with the letter " M."

A county for the purpose of restrictions on movements includes all the boroughs therein.

(5) *Restrictions on exposure of sheep at markets during the dipping period, 15th July to 31st August.*—All sheep exposed for sale in any market, fairground or saleyard during the dipping period (15th July to 31st August), must have been double dipped during that period or within the twenty-eight days immediately preceding the date of exposure for sale, and must be accompanied by a written declaration showing particulars of the dippings.

All markets, fairs or sales of sheep help during the dipping period must be authorised by the Local Authority. This will be done on the condition either—

(*a*) that an Inspector of the Local Authority will attend the market or sale to receive declarations and certificates showing that the sheep brought to the market or sale have been duly double dipped, and also to issue certificates to purchasers giving them the dates of the dippings, to be utilised where required for the purpose of the further movement of the sheep, or

(*b*) that the Market Authority or auctioneer will, if authorised by the Local Authority, receive such declarations and certificates showing that the sheep brought to the market or sale have been double dipped, and issue certificates to purchasers as above.

The above requirement as to dipping of sheep exposed at a market will not apply to a market, fair or sale authorised by the Local Authority to be held exclusively for fat sheep intended for immediate slaughter. All sheep exposed at such a market or sale must be moved under licence direct to a slaughterhouse.

(6) *Provisions applicable to exempted counties.*—The following provisions will apply throughout the year to any county which has been declared by the Minister to be exempt from the general compulsory double dipping required by the Order, the object being to provide a continuous protection from the risk of the reintroduction of scab from non-exempted counties:—

(*a*) The arrival of sheep moved into such county from any county not exempted must be notified to the Local Authority and the sheep must be double dipped as soon as practicable after arrival at a farm in the exempted county.

(*b*) Where sheep from outside an exempted county are exposed at a market or sale in an exempted county, *all* the sheep at such market or sale must, on removal to a place of destination (other than a slaughterhouse) in an exempted county, be double dipped on arrival at the place of destination. The Local Authority will have power to authorise special markets in an exempted county at which none but sheep from within an exempted county will be exposed. In these cases dipping of the sheep exposed at the market will not be required on removal to a place of destination in an exempted county.

(c) The above provisions relating to exempted counties will not apply to sheep accompanied by a certificate of the Local Authority of the district from which they come, stating that they were double dipped under supervision during the double dipping period (15th July to 31st August); that the second of the two dippings took place within twenty-eight days before movement; and that since the second dipping the sheep were kept separate from undipped sheep.

(7) *The following Orders will be revoked*:—

(a) The Sheep Scab Order of 1923, which places upon sheep owners the onus of taking all reasonable steps to keep their sheep free from scab. This Order has not been found practicable to enforce effectively.

(b) The provisions of Article 12 of the Sheep Scab Order of 1920, as amended by the Sheep Scab (Amendment) Order of 1923, empowering Local Authorities to make regulations requiring the dipping of sheep moved into their districts, and requiring the general dipping of sheep in their districts. It is considered that the eradication plan described above will obviate the necessity for the existence of the present local regulations.

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VISIT OF THE AMERICAN YOUNG FARMERS' CATTLE JUDGING TEAM TO EUROPE, 1925.

THE championship for judging dairy cattle open to the Young Farmers' Clubs of the United States of America was won last autumn at Milwaukee by a team from the Franklin County Dairy Calf Club, Iowa. The team consisted of three boys: Harlan Leonard, aged 19; Raymond Monahan, aged 18; and Lester Olsen, aged 18, and had been trained by Mr. V. B. Hamilton, the County Agriculturist of Franklin. This team had successfully competed with 19 other teams, the local champions of their respective counties in the State of Iowa. Similar eliminating contests had taken place in 24 States, so that the Franklin team won the championship against approximately 50,000 competitors. The prize included a trip to Europe, the State to which the winning team belonged giving 4,000 dollars and the various Dairy Associations adding a further 750 dollars towards the expenses of the trip. It appears to be an established custom for the winning State to subscribe the amount named. It is of interest to note that Franklin County teams won the State championship in fat stock judging, and the National Championship for bread-baking open to girls in connection with Young Farmers' Clubs. There are 368,640

Fig. 1.—Judging Shorthorns

Fig. 2.—Judging Jerseys.

acres in the county and 2,300 farmers. The land is valued at 200 dollars per acre. The team left Iowa on 24th May and visited Washington en route, travelling thence to Montreal and Liverpool and reaching London on 8th June. The boys were accompanied by Mr. and Mrs. V. B. Hamilton and Mr. Earl Weaver, Professor of Dairy Husbandry at the Iowa State College of Agriculture, Ames, Iowa.

The party was entertained at luncheon at the Farmers' Club, Whitehall Court, on 9th June, Miss Pratt and Mr. Robinson, of the Ministry, being present. After lunch, Westminster Abbey and the Government Buildings in Whitehall were visited, and later a programme for a tour on the Continent and to the Channel Islands was arranged for the visitors. The tour included Holland, Denmark, Switzerland, France and Germany, Jersey and Guernsey. The party travelled by air from London to Amsterdam.

Returning to London on the morning of 2nd July, Lord Astor's Cliveden Estate at Taplow was visited during the afternoon. Miss Pratt and Mr. Robinson accompanied the party to Cookham, where Mr. Hubert Smith, Lord Astor's agent, met them and conducted them round the farm, where an opportunity was afforded the visitors to see and handle some Dairy Shorthorns. The stud farm was also visited, the thoroughbred mares with foals at foot being seen. Mr. and Mrs. Smith entertained the party to tea.

On Friday afternoon, 3rd July, Mr. Robinson accompanied the visitors to Derby, an interesting programme having been arranged by Mr. J. R. Bond, County Agricultural Organiser. The party stayed at the Royal Hotel, Derby, from Friday until the following Monday. At 7.30 p.m. on Friday a cattle judging contest took place at Mr. Henry Adams' farm at Shipley, where some good Dairy Shorthorns were seen. Mr. and Mrs. Adams entertained a large party to supper after the contest.

On Saturday morning a visit was paid to Mr. Gilbert's herds of Lincoln Reds and Friesians at Chellaston, after which Mr. Gilbert took the party back to Derby for lunch. In the afternoon another contest was carried out with the Kilburn team at Mr. C. C. Mort's farm at Holbrooke, near Derby.

Sunday was spent in the fields looking at Mr. Gilbert's and Mr. Mort's cattle.

The party left Derby at 3 o'clock on Monday for Reaseheath, Nantwich, where rooms had been booked through the kindness

of Mr. Mercer, of the Cheshire School of Agriculture, so as to afford an opportunity of visiting the Royal Show at Chester.

On Tuesday and Wednesday, 7th and 8th July, the party visited the Royal Show, and on Wednesday evening Professor Weaver paid a private visit to Wigtonshire, while the rest of the American party proceeded to Edinburgh until the morning of 15th July. Professor J. A. S. Watson, of Edinburgh University, arranged an interesting programme for this part of the tour, which included a visit to the Highland and Agricultural Society's Show at Glasgow on 14th July. The party arrived back in London on the evening of 15th July. On 17th July the Fourth International Dairy Cattle Judging Contest for Young Farmers' Clubs took place in the Reading district, between the American team and the following team representing England: Dorothy Dean, aged 17, Northease Jersey Calf Club; Ronald Knight, aged 18, of the same Club; Leslie White, aged 17, Hemyock Calf Club. The American team won by 28 points and carried off the *Daily Mail* gold challenge cup. An account of this contest was given in the August issue of this *Journal*, p. 475. Photographs relating to it accompany the present note.

Shopping and sight-seeing occupied the American visitors until the afternoon of Tuesday, 21st July, when Mr. Robinson took them to Windsor. Mr. Conacher, the manager of the Royal farms, spent a couple of hours taking the party round the farm buildings and showing the dairy and the various herds.

On the afternoon of 22nd July, Lord Balniel, M.P., escorted the Young Farmers, with Miss Pratt and Mr. Robinson, round the House of Commons and was also good enough to obtain tickets to enable them to hear a debate.

Mr. Raymond Monahan went to Ireland from 18th-22nd July, visiting Belfast, Dublin and Cork, and was given letters of introduction by the Ministry of Agriculture in Dublin to a few farms and Farm Institutes.

The American party left Waterloo on 23rd July for Southampton to embark for New York on the U.S. liner "George Washington."

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COUNCIL OF AGRICULTURE FOR ENGLAND.

A special meeting of the Council was held at the Middlesex Guildhall, Westminster, on Thursday, 6th August, 1925, to consider the Report of the Committee which had been set up to make recommendations to the Council for suggestions to the Minister of Agriculture on the question of the Agricultural Policy for the Country. Mr. James Donaldson (Oxfordshire) was in the Chair, and the Right Hon. Edward Wood, M.P., Minister of Agriculture, was present during the greater part of the proceedings.

Lord Clinton, Chairman of the Committee, presented the Report. He referred to the representative character of the Committee and to the fact that the Report had been signed by ten of the eleven members of the Committee, with reservations by two of them, viz., Mr. C. S. Orwin and Sir Douglas Newton. It was understood that the members, although drawn from landowners, tenants and workers (Lord Clinton, Sir Douglas Newton, Lord Selborne, landowners; Mr. Donaldson, Mr. George Rea, Captain Morris, tenants; Mr. George Edwards, Mr. George Hewitt, Mr. Tom Lovell, workers; and Mr. C. S. Orwin, agricultural economist), did not, in sitting on the Committee, represent any organisations connected with Agriculture. Lord Clinton said he would, with permission, take the Report in two parts, the first relating to the Subsidy for Production and Employment, the second referring to a Permanent Policy.

With regard to the first part, he said that the Government had asked assistance in the matter and had laid it down that the object in view was to secure that the industry be conducted in such a manner as will secure the maximum employment of labour at reasonable rates of wages together with the full use of the land for the production of food at the lowest possible prices consistent with a fair return to those engaged in the industry. The only method to achieve this was to increase the arable area, and that could not be done under present conditions except by State aid. Subsidies in themselves were objectionable and uneconomic. They led men to rely upon the State rather than to their own individual efforts, and were only admissible when the imperative need of the nation demanded them.

Arable farming was difficult to maintain, because of unrestricted foreign competition and the consequent slump in home

cereal prices to the level of world prices. Then there were the vagaries of the British climate and the heavy taxation of agricultural land. These and other causes meant the laying down of land to grass, lower production and less employment of labour—all evils which directly affected the State itself. He did not envy those in power who had the responsibility of taking a decision in circumstances so difficult. The Committee's recommendation was, however, clear. It had gone further than any other body in suggesting the actual form of a suitable subsidy. It recommended a subsidy of £2 per acre on the fallow land or fallow crop in every farming rotation, not more than one quarter of the arable land of a holding to count for subsidy in any one year.

The main objects of such a subsidy were to maintain the land in good condition full of fertility capable of being turned to the nation's use at short notice, and, secondly, to maintain upon the land the full complement of men and horses, of implements, machinery, and husbandry. A subsidy for cereal crops alone, in so far as it encourages the growth of those crops to an unnecessary degree might defeat the very object aimed at, because, by over-production of those crops, the fertility of the land would be reduced, and the attainment of a high state of efficiency at the moment it was wanted would be prevented. Other objects and advantages were laid down in paragraphs 5, 6 and 7 of the Report. Lord Clinton added that the fallow, being the foundation of our farming systems, its treatment necessarily governed the whole rotation.

Mr. W. R. Smith, in opposing the subsidy, stated that whenever agriculturists got down to consider this question it was always the suggestion of a subsidy that emerged from their deliberations, and, although they did not ask for it, it was rather interesting to know that side by side with the declaration that they wished to be left alone they were always asking the State to do something for them and the position in that respect was a little contradictory. It was easy even with the best of intentions to do more harm than good even by a policy of this description. The 1920 Act, in opening up possibilities and hopes to agriculturists, did more harm to the industry than if it had never been passed at all; and agriculturists should hesitate before they attempted to evolve a policy which was likely to have only a very short existence. He did not think that there was a single person in the hall who could state with any confidence that the subsidy would naturally and necessarily bring a

single acre more land under the plough than existed before. It was a speculation at most. He asked whether potatoes were to be covered by the definition of fallow crops. If so, money would be given away for nothing. Not one single degree would be added to the efficiency of the soil by the subsidy in regard to that class of farm and £2 per acre will be a direct gift to those farmers, without the country getting anything in return. We had the very best farmers in this country that there are in the world and land was in many respects cultivated to the highest point.

In the remainder of the Report, a series of suggestions was being put forward and practically all were going to cost money. Agriculture was now receiving grants amounting to 4½ millions a year. The Minister had said recently in the House of Commons that "the average farmer will not realise that he is about as capable of buying his supplies on level terms from the wholesalers or merchants as the average housewife would be of making a good bargain for the household tea supply if she went to Mincing Lane." That was rather a damaging statement, and supporters of agriculture and farmers would have to remove the grounds for it before they came to the country and asked for subsidies in the way they were now doing in this report.

Sir Walter Berry said that he had recently journeyed to Scotland by one road and back by another and had motored from Canterbury into Gloucestershire by one road and back by another; he had been by train to Lincoln and motored from Lincoln to Norwich and back to London by train. With the exception of a very small portion of the country he had seen, agriculture was in a deplorable condition and hopeless unless something was done. Weeds in corn land were due mainly to the want of fallowing, and farmers could not afford to fallow their land at present because of the cost, and so were muddling on. During the war land had got into bad condition, in which it still was, farmers being unable to overtake the weeds. He was strongly in favour of the proposed subsidy and hoped that the Council would not be side-tracked into any discussions which were beside the mark with a view to killing it.

Mr. W. W. West (Isle of Ely) said he did not agree with giving the subsidy for fallowing, it should rather be given on the actual crops required and produced. He was Chairman of the Isle of Ely Agricultural Committee, and the Director of Agriculture had plenty to do without going all over the farms and seeing how much land was fallowed and how much crops

was grown on it. In his district, farmers could not afford to fallow the land unless growing potatoes were fallowing.

Mr. Bruford (*Somerset*) asked whether the Government had made up its mind to give a subsidy to agriculture as it had done to mining. He thought a subsidy on arable land was useless : his own land would not be cultivated better or produce more on account of it, and there were many other farms in the same position. The proper method of going to work was to stabilise the price of corn at 60s. at least.

Captain Morris (*Herts*) said that in his opinion the subsidy, for the great bulk of the land in the country, required no defence. It was quite easy to put up destructive criticism, but the Council's Committee had produced a constructive proposal which would certainly be for the benefit of the nation with regard to the poor and the medium class soils. They (the destructive critics) were speaking for a very small proportion of agriculture in the country. He knew particularly with regard to one county, that something like 80 per cent. of its small-holdings this year were under white straw crops. That was not in the interests of the smallholder or in the interests of the nation. He wished to suggest that this subsidy was an entirely different proposition from the ordinary subsidy, because in the main it was paid for something being done. He had a lively recollection of other subsidies which gave something for nothing, but here there was in this fallow or fallow crop subsidy an absolute certainty of successful cereal growth afterwards and the easiest possible form of inspection of agricultural land. Was it suggested that to get a fourth of the land in this country put in a fertile condition was of no benefit to the nation, or that that land could be put into a better condition of fertility without more employment of labour? He appealed to the Council to lift the question out of the ruck of party politics and consider it on its merits. He was absolutely convinced that the subsidy would do much to improve the arable acreage; also that the nation could not continue to go on with regard to agriculture as it was doing. It was surely in the interest of the nation to stop the decline in the arable area. Did the nation require more population in its rural areas, or did it not care? He asked objectors what they had got to put in place of the unanimous report of the representatives of all three parties connected with the land?

Mr. George Edwards, in the course of his speech, said he had had experience of agriculture for nearly 75 years. In the last 30 years, the numbers of labourers had dropped from

900,000 to 600,000 and there were 3,000,000 acres less under the plough. Further, the quality of arable land to-day was not more than 70 per cent. of what it was 30 or 40 years ago. Mr. Smith had said that if the subsidy were given there was no guarantee that one more acre of land would be brought under cultivation. He would analyse that. The suggestion in the Report was that the granting of a subsidy was to be placed in the hands of County Agricultural Committees, and they would not give it unless they were satisfied that the land was being properly cultivated. Some land therefore would not be growing weeds or thistles or docks. On the other hand, the best would be got out of the land, which could not be well cultivated unless more labour were employed. He was getting alarmed at the depopulation of the villages, and at the physique of the people that were being reared in the villages.

The Report desired to see a return to the proper rotation of crops, because land would not stand a continuity of white crops. That was the objection to giving a subsidy on corn or wheat. The Committee did not want to encourage the farmer for the sake of getting the money to grow corn continually. It objected to Mr. Orwin's proposals in respect of a graded subsidy on agricultural land after considering them. That would cut out the smallholder, because it so happened that the man with the least land had to pay the highest rent. The Committee's proposal would benefit the smallholder. As to wages, it could be left to the Wages Board to see to it that labour was protected, and that labourers would get the highest and best wages that the industry could pay.

Mr. George Nicholls said that he had been unable to sign the Report because he could not agree that the subsidy was the best proposal that could be made for agriculture. He gave his reasons for that view, and said that he would be prepared to put up other suggestions for a better solution of the problem.

Mr. George Dallas considered that it should be made clear that the Report was not one by the three parties in agriculture, it was made by individuals only. He suggested that agriculture got enough subsidy as it was: it also had a Department of State to look after its interests.

Alderman Davis (Durham) said he was a firm believer in the policy of the bare fallow: a crop looked brighter and better after it. He thought landlords might be asked to forego the rent whilst the land was in bare fallow. He did not, however, agree with the subsidy.

Mr. John Evens (*Lincs*) said that in his view there were two clear-cut issues—what the farmer wants and what the nation wants. A few years before the war he had 700 acres of arable land and 300 acres of pasture. Within the last two or three years he had seeded down 200 acres and had to-day about 500 acres of each. If present conditions continued with regard to costs and prices, he would seed a little more down, and go on in that way because that was the only method in which he could economically manage his farm. The best land would take care of itself, but most of the country could be classed only as three or four quarters an acre land. If that land were to remain under cereal cultivation, some way must be found which would help it to be profitably done. The proposals before the Council were likely to do that more surely than anything else that had been put forward.

Mr. F. T. K. Cross (*Berks*) supported the adoption of the Report though he disliked the principle of subsidies. If the nation wanted more arable land then the policy outlined was the best to adopt.

Mr. George Hewitt, a member of the Committee, said that the criticisms had come from the people who did not live as near to the land as those who had had the honour of drafting the Report. Advocating a subsidy on fallow land would seem very strange to people who did not live directly from the land. The nation would get back in four years a cleaner country than it had to-day, and if one quarter of the land could be cleaned by this means certainly the land would be a greater asset to the nation. He failed to see why the man who grew corn should not have as high a standard of living as the man in the town who made shoes for him. It was a national problem and agriculture should be assisted.

Mr. Haman Porter said he could not vote for the Report because he saw vast dangers behind it, of which nationalisation of land was one.

Mr. Quinney (*Birmingham*) said he would vote with the Committee on both sections of the Report. Farmers had never asked for a subsidy, but when the Government of the day said they wanted certain things done, certain alterations on the land made in the national interest, farmers wanted to obey, but as reasonable men they had to be safeguarded against loss. For that reason he was quite prepared to swallow the word which is hateful to the ears of the Englishman, viz., subsidy.

Mr. R. L. Walker (*Yorks, W.R.*) said that the good land would have to be considered, and that there was much that would require no subsidy at all; moreover many farmers would not care to receive it. As to smallholders in the West Riding, it would be difficult to justify a subsidy except in the case of a very few.

Mr. Ashby said that agriculture to-day was as well able to stand upon its own feet as any other productive industry in this country, and better than most. There were farmers, and in some districts the majority of farmers, who were to-day better off as regards capital, profits, and income than they were in 1913, even if allowance were made for the reduction in the value of money. The speculation of the subsidy was one in which every scrap of evidence that exists was against the speculation. Under the Agriculture Act of 1920, thirteen or fourteen million pounds had been paid in January, 1922. In that very year, the arable acreage of this country went down. In proportion to the total agricultural land, the arable area was as great to-day as it was in 1913, the only difference being that the total area has shrunk very considerably.

Mr. W. B. Taylor (*Norfolk*) expressed thanks to the Committee for the Report so far as Norfolk was concerned; it was not so much whether the individual farmer was making money or whether he was not, because good business men would make money in almost any industry, bad as the times were even to-day. Two-thirds of the land of Norfolk was only second-class land, and a good deal only third-class land. The returns from that land showed a constant increase in the acreage laid down to grass which was not its best use, and, slowly but surely, the country districts were being depopulated in consequence, which meant loss to the nation. He criticised the Report in that it gave no guarantee to workers that they would get a proportion of the subsidy. He considered also that smallholders should have their rates remitted, and some of their rents, where the latter were unfair.

Mr. Matthews (*Hereford*) asked whether all members of the Council had been requested to send in suggestions as to Agricultural Policy to the Committee, and if so, why the critics had not sent in their proposals. The Chairman replied to the first part of the question in the affirmative. Mr. Matthews went on to commend the Report, particularly for the smallholders.

Mr. Rea (Northumberland) asked the critics of the Report if they were prepared to follow their objection to its logical conclusion. If this Report were defeated and nothing done, then it is almost directly saying to the farmers, "Do as you like, lay your land down to grass as far as you please." Were they prepared to face the national danger which will confront the country in the event of another war? Were they prepared also to say to the rural workers, "We don't care anything for your interests, we are not going to help the farmers to take you in employment. If the farmers cannot do that off their own bat you will have to look after yourselves." He paid a tribute to the work of Mr. George Edwards and his labour colleagues on the Committee. He asked whether Mr. Smith and Mr. Dallas were prepared to go to the country and say to the workers whom they represent, "We can do nothing for you, and we don't agree that anything should be done to help agriculture, so of course you run the risk of losing your employment." The logical conclusion of that position was that the Wages Board must be scrapped and the whole industry allowed to go to pieces.

Mr. R. C. Grey (Hunts) pointed out that with the subsidy would go inspection, enquiry and demands for more wages. He was, however, prepared to support some such proposal if only to grade the bad farmer. He preferred Mr. Orwin's reservation to the Report itself. If his reservation were adopted, inspection would extend to the whole arable area.

Sir Douglas Newton (Cambs) said that the Report had at any rate served one good purpose in the interchange of ideas which had taken place; that could only be for the good of all and for the industry as a whole. The problem, so far as he had visualised it was how best to maintain the food supplies of the nation, the rates of pay of the workers engaged in the industry, and ensure a reasonable return to farmers. Now, so far as the food supplies were concerned, that was a national question and not for the Council to determine; but with regard to the wages of the worker. They must be finally determined on economic lines and according to the success and prosperity of the industry. That was immediately a farmer's point, and he had hoped to hear more upon it.

Mr. Fawkes (Yorks, W.R.) enquired what the administrative cost of the proposal was likely to be. The Chairman said the Committee was assured that it would not be great.

The discussion of the first part of the Report was then closed, and *Lord Clinton*, in replying to the debate, said that he thought the real point of the subsidy proposal had been missed in the discussion. Over and over again speakers had spoken of the subsidy as a means to enable the farmer "to carry on." It was nothing of the kind. In this Report—and he had taken the greatest pains in his opening speech to say it—there was a great distinction drawn between the industrial and the national side. From the industrial side, nothing had been said about a subsidy—farmers could still hold their own; they could make a living. Under the arable system, to which the labour critics should have paid more attention, there was no way except by it that a satisfactory number of men could be kept employed on the land. There was no other way in agriculture under which you could give them a decent rate of wage.

The Chairman then put the motion in favour of the adoption of the Report; it was carried by 49 votes to 14.

Lord Clinton then proposed the adoption of the second part of the Report under which the following are the headings of the paragraphs:—Permanent Policy; Application of Agricultural Education and Research to Agriculture; Small Holdings, Cottage Holdings, and Rural Housing; Agricultural Credit; Better Marketing and Transport of Agricultural Produce; Steadying of Agricultural Prices; Burdens on Land; Land Drainage; and Liming. He dealt briefly with each heading.

Mr. Gibbons (*Gloucester*) expressed himself more in favour of assisting smallholders than in giving a subsidy to farmers; the question of loans to smallholders had, however, after the experience under the Land Settlement Act provisions, to be very carefully dealt with in the counties. He also laid stress on the need for better drainage.

Mr. J. Lousley (*Berks*) said that loans to smallholders in his county had gone very well indeed.

Mr. Gardner (Worcs) said that rural schools should give a thorough grounding in the elements of education and should specialize afterwards. Housing, also, was a most important matter, the crux of success with small and large holdings. He also dealt with the other items in Part II.

Lord Bledisloe, Parliamentary Secretary to the Ministry, said in reply to a question by *Mr. Thomas (Hants)* as to the Drainage Bill, that the Bill would be introduced into Parliament next year at latest, and possibly in the autumn session of this year.

The Cabinet yesterday had decided to continue the grants for unemployment work on drainage for the coming winter. A considerable sum of money was also about to be devoted to drainage work as carried out by Drainage Boards and Commissioners of Sewers for the period of the next five years. Mr. Gardner had supported liming; at the Ministry it was considered that there was enormous scope for land improvement by liming, and, as Lord Clinton had said, it was not much good to lime seriously undrained or waterlogged land.

Mr. Clement Smith (*Suffolk*) said that in East Suffolk there was a large acreage of light land that required liming. He had just recently had an opportunity of paying an extended visit to Holland, and one thing he had noticed was the improved methods of marketing agricultural produce.

Mr. Dallas congratulated the Committee on the excellent second part of the Report. He did not agree about elementary education, however. All education of an elementary character should be without any occupational basis whatever. All the children who go to the elementary schools were not the children of agricultural workers or the children of farmers, and were not necessarily going into agriculture.

Lady Mabel Smith spoke on the subjects of elementary education, and the position of women in regard to agriculture. Women were persuading the men to leave the country districts because they feel their children have not the facilities there for elementary education, for extended education, and for finding work afterwards, as have the children of the urban and town worker; so that anything the Council could do by way of obtaining improved educational facilities would be of great value.

Mr. Hamilton (*Lancs*) spoke in favour of the Report, and *Lord Selborne* dealt with the criticism that had been made as to the recommendations on education. There was undoubtedly at present an anti-rural bias in many of our country elementary schools. He did not think that it was conscious or intentional; it had come from the fact that some of the teachers—most devoted and splendid people—had no special appreciation or experience of the country. What was meant by a rural bias, which might first begin with the teacher and then be communicated to the child, was that he should be taught the glories of country life, and more nature study. He should not grow up to look down upon agriculture as a despised and degraded industry, but should be taught to understand that it is one of

the most noble industries and professions, and that the agricultural labourer, so far from being an unskilled man, was a very skilled man indeed.

Mr. H. Thomas (*Hants*) suggested that unemployed labour should be used for the chalking of land.

Mr. W. R. Smith, in supporting the second part of the Report, criticised certain details in regard to a smallholdings policy, housing and drainage.

Mr. George Nicholls also said he wished to support this part of the Report. He replied to Mr. Smith's criticisms on smallholdings policy.

Mr. A. R. White (*Wilts*) said he wished to support the extension of smallholdings. In regard to water supply, he hoped that the Government would include that kind of scheme in their land drainage work.

Lord Bledisloe replied that he was not yet in a position to give an undertaking that water supply schemes would be included. He said that the Ministry was profoundly grateful to this Council for submitting this report on the question of agricultural policy. It obviously had involved a great amount of earnest work, and whether the Ministry was able to submit to the Government these particular proposals or not, the Council might be assured they would have the deepest consideration. In one respect, the proposed Government policy had been definitely announced, viz., in regard to smallholdings, and he was glad to note that there had been expressions of keenness, if not enthusiasm, in relation to this topic, from all parts of the Council. The Government realised, in connection with smallholdings, that whatever may be the case with regard to larger holdings, co-operation was absolutely essential if economic success was to be achieved.

Lord Clinton briefly replied to the discussion, and thanked the Council for the response it had given to the Report.

The Chairman put the second part of the Report, which was carried without any dissentient vote.

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THE OTTER.

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THE otter (*Lutra vulgaris* or *Lutra lutra*) belongs to the same family (*Mustelidæ*) as the badgers and stoats, and is ranked in the bear-like section of the order of Carnivores. That is to say, its affinities are rather with bears than with cats or with dogs. It is one of the oldest mammals in Britain (its bones have been found in the Norwich Crag of the Later Pliocene period), and it has established itself in all parts of the country. It is commoner than is supposed, but it readily escapes observation owing to its elusive ways and to the fact that it works a good deal under cover of darkness. It frequents streams where there is good fishing, and lakes as well; in some parts of the country it hides in caves by the sea shore and swims out to adjacent islands. It must be regarded as a very successful animal for, in spite of much persecution, it enjoys a wide distribution both in the Old World and the New, especially in the more northern parts. The "holt" or "hover" is in most cases a well hidden hole by the side of the stream, and the exit is usually under water so that the tenant can slip quietly away. Although the otter is so much at home in the water, it likes to rest and sleep in a dry place, and the "nest" is often made comfortable with reeds and grasses bitten into short pieces. In some cases the same otter seems to have several "holts."

Some Characteristic Features.—The otter has a long strong body, 2 to 2½ ft. in length, and a very muscular steering tail which extends for about 16-20 inches more. The head is broad and rather low, with large eyes, long, thick, sensitive whisker-hairs or vibrissæ, and short ear-trumpets with openings that can be closed in diving. Very striking on the cleaned skull is the deep locking of the lower jaw into its socket, for the otter takes a firm grip of things. There is fine moulding about the skull, and the ridges for the insertion of the muscles of the jaw and neck bespeak great strength. There are sharp prominences on the back teeth that help the otter to keep hold of a slippery fish. The short strong limbs are both webbed and clawed, equally well suited for swimming and burrowing. There is the usual pair of odoriferous glands under the broad

Fig. 1.—The Otter

root of the tail. A not uncommon weight for a dog otter is 20-25 lb., and 15-18 lb. for the female, but much heavier individuals have been recorded. Roughly speaking we may calculate a pound in weight for every inch in the length of the head and trunk. The otter is deep brown above, grey to yellowish grey below; but very dark-coloured varieties sometimes occur. As is usual, there are long outer hairs and a lighter under-fur. It is interesting to notice how greatly the shape of the animal changes when the outer hairs get thoroughly wetted, but whether wet or dry the otter is an animal of fine lines, indicative of its athletic development. Its whole appearance suggests power, yet without the heaviness of the badger or the bear.

The Otter's Bill of Fare.—One of the reasons why the otter holds its own that it can thrive on so many different kinds of animals. In the main, it depends on eels, trout, salmon, pike, flatfish and the like, but it also condescends to eat snakes, fresh-water mussels and worms. It does not despise the edible mussels on the sea-shore, breaking the shells with its teeth, and it will also take limpets from the rocks. The frogs from the marsh are a delicacy, and so are young rabbits and wild duck. The otter has certainly a very wide range of appetite, and there is no denying that it may take chickens and ducklings, and other young birds, though the damage done in this way is quite trivial. There is no disputing that it levies toll on trout and salmon, often biting them in the throat and getting a draught of blood from the heart. But as Millais points out in his *Mammals of Great Britain*, "taking everything into consideration, otters do no harm to fish, even on big salmon rivers, and he is a churlish fisherman indeed who grudges this graceful creature his share." The fact is that otters devour many other fishes besides trout and salmon, that their check on the multiplication of eels and pike is all to the good, and that they are also useful in getting rid of the old male trout, which are very fond of the spawn and fry of their kind. In all these cases, one must take a broad view.

Habits.—The otter has very keen senses of sight, hearing, touch and smell, and it is almost impossible to catch one napping. It has a fine brain and is extraordinarily resourceful as well as alert. It is equally at home on land and in water, by night and by day, in a dry burrow or on a shelf under a

waterfall; it can enter the pool without a splash and swim near the surface with scarce a ripple; it can dive in the sea in a spiral full fathoms five, and lie under the bank on a stream for hours, with its nostrils raised into a space between water and earth. It knows its own footsteps in the thicket and will not retrace them; it almost never goes back to a kill, for that way danger lies; it will carry a water-trap on its shoulders and wrench it off on the roots of an alder-tree; it will dive at the flash of the gun and elude the bullet; it is an outlaw of unsurpassed alertness and resource.

Its severest trial is a hard and prolonged frost, when the waters of the lake are sealed. The otter may hunt for pike beneath the ice, or for eels and tench buried deep in the mud—but this is a terribly dangerous expedient. There are wild-fowl to be sought after, but they also have to leave the frozen waters. It is then that the otter in desperation will begin to inquire by night into the state of the farmer's poultry-yard.

Mr. J. C. Tregarthen's *Life Story of the Otter* is a very fine piece of work, based on a lifetime of observation of this very unapproachable animal. One of the features that he emphasises is the otter's roving disposition. "The homeless hunter," he calls it, "the Bedouin of the wild." "It has been known to travel fifteen miles in a night, and not infrequently the holts where it lies up during the day are ten or twelve miles apart." The otter passes from tarn to stream, from river to shore; it swims far out to sea and reaches isolated rocks; it wanders along the cliffs and explores the caves; it crosses the heath-covered hills and even the mountain passes, sheltering among the bracken or in the heart of a cairn; it neither stores nor hibernates, but is always on the move—a gipsy among carnivores. It is plain that the restlessness of habit will increase the otter's chances of life.

The agility of the otter in climbing and jumping, as well as in swimming and diving, is past all praise. In swimming near the surface it uses both fore and hind feet. In deep swimming it uses only the fore feet. The hind feet are stretched out behind and the tail serves as a kind of rudder. It can remain a long time below the surface, even under the ice, but in some reported cases of prolonged immersion it has probably been to the surface unnoticed. The otter's cry is a long whistle, and the creature hisses like a cat when attacked.

Family Affairs.—Otters seem to be monogamous and have strong maternal instincts. There may be savage fights

between two rival dog-otters who desire the same mate. The female is rather smaller than the male. There is usually but one litter in the year, and gestation occupies sixty-three days. Before she gives birth, the female selects and prepares a suitable and inaccessible cradle for the young, who are for a long time helpless. The birth may occur in any month, but the commonest time seems to be about mid-winter. The young ones are born blind and downy, and they cry a great deal. The mother will hardly leave them save on hasty rushes after the food necessary to keep up the supply of milk. When the cubs open their eyes, after about 35 days, the mother cautiously carries them out to bask for a while in the winter sunshine. Even before the young one can see, the mother may carry it in its mouth in the water, perhaps shifting from a threatened nest to a safer one. The number in a litter rarely exceeds three, and there may be only one.

Education of the Young.—This is a case where the small size of the family is compensated for by the good send-off in life that is secured. According to Mr. Tregarthen and others, there is more than maternal care, there is a detailed education of the young by the mother. This is a fact of considerable importance, for it indicates that survival depends not only on individual learning but on parental instruction as well.

When the cubs are able to clamber about, they are taught what may be called the " woodcraft " of the immediate vicinity of the " hover." They learn the alphabet of sounds, some indicating danger and some not. It has been observed that the mother punishes disobedient foolhardiness—especially on the part of male cubs. Yet she is a playful mother, sharing in the frolics of her children. Young otters are among the most delightfully playful of animals, and the significance of this is threefold. Play is a safety valve for overflowing energy and spirits; it affords opportunity to express and test originalities (variations in behaviour) if the young creature has any; and it is a not too responsible apprenticeship before the serious business of life begins. Play is the young form of work. What is particularly striking in the case of the otter is that the play period is greatly prolonged. " Even the fathers and mothers of families cannot resist the appeal of situations that suggest a frolic, and they will play up to the very gates of death."

The young cubs show some reluctance to take to the water—an interesting indication of the secondary nature of the otter's aquatic habits. But the cubs have no choice, for soon after

they can see and are able to follow the mother afield—perhaps two months old—they are taken to a quiet pool and taught to swim and dive. After about a week's teaching, it is said, the cubs can swim like fishes.

According to the expert observers, the young cubs have also to learn to like the taste of fish, to catch them without fumbling, and to eat them in the proper way—the eel from the tail and the trout from the head. They have to learn how to catch frogs in the quag and to take off the unpalatable skin. They have to learn to guddle for trout and eels; how to detect the plaice in the shallow waters of the bay, hidden in or against the sand with only their eyes showing. They have to learn how to deal with rabbit and moorhen, snake and mussel. They have to practise the diverse ways of lying *perdu* in and out of the water. Also, through it all, they have to keep working away at the long alphabet of danger-sounds—especially those proceeding from man and dog.

The otter has not much to do with agriculture, but it has its share in the balance of Nature, and it is a peculiarly instructive creature. It helps us greatly to a Darwinian grasp of the breadth and depth and subtlety of the struggle for existence. When we ask how the otter survives in an inhospitable country like Britain, we have to recognise that this depends on much besides the animal's natural gifts of strength and agility, keen senses and good brains. The otter's survival depends in part on the very careful mothering, on the detailed education that results in a resourcefulness that can hardly be baffled, and on the roving disposition which becomes expressed in an unrivalled elusiveness. Long live the otter!

* * * * * *

TRIALS OF SPRING CABBAGE IN NORTHUMBERLAND.

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THE spring cabbage is one of the important and often most remunerative of market garden crops, but the rapidity with which it loses condition after being cut necessitates production within reasonable distances of the markets. Fortunately its adaptability in respect to soil and climate, is, within the range of the numerous varieties, very great. An evolved form of the wild cabbage (*Brassica oleracea*), and long known to cultivation, its chief characteristics are freedom from "bolting"

—*i.e.*, running to seed—hardiness, and rapid hearting. As already mentioned, it exists in numerous varieties, and one of the main objects of the trials dealt with below has been to demonstrate which varieties are most profitable for production in Northumberland.

Spring Cabbage Cultivation in Northumberland.—The sole aim of the cabbage grower in Northumberland is to supply the populous mining and industrial areas of the north-east of England—only on rare occasions has it been found worth while to send cabbages farther afield. The principal present areas of cultivation are to be found around Morpeth, and in the Tyne Valley at Wylam, Corbridge and Hexham. Morpeth is the Evesham, so to speak, of the north-east. Probably over a thousand acres of market gardens exist within the precincts of the ancient borough. Brassica constitutes the principal crop and the spring cabbage is grown to perfection. Readers of more southerly climes will be impressed most of all perhaps by the early date of sowing this crop—from the 10th-15th July. As may be imagined, forward plants are available for planting out at the beginning of September, or, as last year, earlier. Experience shows this to be the true way to get an early cut. The plants often look large and unduly forward at the beginning of winter and may come in for some rough handling in the event of severe weather, but they are there in the spring, strongly rooted, and ready to jump into growth at the first spell of favourable weather. Practically all of the spring cabbages grown are from home-saved seed. A fairly large, second-early type is preferred. The small quick-hearting forms such as Ellam's Early Dwarf and Harbinger are almost entirely taboo at present, being found uncertain in constitution. In selecting plants for seed production those conforming most to type are marked with a stick; the head is cut and marketed, and the sprouted stump eventually removed to flowering quarters. Since this is done by quite a number of neighbouring growers many might wonder how they manage to keep their respective strains distinct. It is, however, explicable by reason of the fact that there is no great difference between them in the first place.

Soil, Manuring, and Planting.—The light, warm and earlier soils are naturally favoured for spring cabbage culture, but some of the stiffer lands have been rendered comparatively light and suitable by long cultivation and manuring. With

regard to the latter, the growers would seem to err on the side of prodigality so generous are the dressings. An application of 50 tons per acre is not infrequent. This is not, of course, farmyard manure, but town material in which midden refuse often bulks largely. Notwithstanding, the growers do not stint the crop, and it is undoubtedly a wise policy. Rotation is scarcely thought of, and judging by results would appear unnecessary from a production standpoint. Planting, done by girls, is very close—some growers, working with a type which produces only a few outer leaves, plant at little more than a foot apart each way. Sixteen inches by fifteen is, however, a more general spacing. Care is taken to keep the crop clean, hand-weeding even being resorted to for this purpose in early spring. A spring stimulant is believed in and usually takes the form of a dressing of sulphate of ammonia at about 3 cwt. per acre applied by hand close to the plants comparatively early in the year—March being the usual time.

Cutting does not commence usually before mid-April, and the bulk of the supplies are marketed in May and June. They are packed in crates, each containing about six dozen, and sent to market twice a week, *e.g.*, on Tuesdays and Thursdays. Only the best heads figure in the earlier consignment. Prices naturally fluctuate, but the normal experience is to start at 3s. per dozen and gradually decline to 1s. 6d. for the best stuff. Very few good heads fetch less, however, than 2s.

The Trials.—These were instituted in 1923 and had for their main object the testing under uniform conditions of soil, manuring, and cultivation, of a number of well-known varieties available from seedsmen, and some of the local strains. The writer acting with the approval of the County Agricultural Education Sub-Committee has been responsible for the organisation of the trials, and was fortunate in obtaining the assistance of two able and conscientious growers in Mr. J. R. Temple, of Morpeth, and Mr. J. Mordue, of Wylam, who undertook the work of cultivation at their respective centres. In practically every detail this was made to conform to that commonly adopted for the normal crop. The initial trial, ending in June, 1924, included 21 stocks, and demonstrated the general superiority of the local growers' strains. Among these were those of Mr. John Cairns with a cabbage known as "W. Y. Price's strain," and Mr. J. R. Temple with his own special selection. Other sorts which stood out prominently were Clucas' "Early Market," "First and Best," from the

same firm; "Early Offenham" from Messrs. W. W. Johnson, Boston, and "McEwan's Early" from Dobbies, Edinburgh.

The second trial, 1924-25 was almost a replica of the first, except that 25 stocks were involved, and, of these, eleven were being tried for the first time. The sowing date for both Morpeth and Wylam was 16th July, 1924. Planting out was done on 5th September at Wylam and 9th September at Morpeth, at approximately the same distances, viz., 16 in. by 15 in. at Morpeth, and 14 in by 14 in. at Wylam. The plants were hoed at both centres in March and nitrogenous salts applied at the end of that month. The plots at Wylam were 1/169th acre in extent, containing originally 180 plants, and at Morpeth 1/22nd acre containing 1,100 plants for each variety. A public inspection (attended by over 60 growers in the case of Morpeth) was held at each centre at the beginning of June. Apart from this the writer paid visits for observation purposes throughout the period of the trials. In both seasons the plants got a good start, but whereas the winter of 1923-24 was marked by considerable severity, that of 1924-25 was exceptionally mild. Only at one period, the second week in March, were the plants subjected to anything like a severe test. Consequently the spring cabbage season for 1925 has been one of the earliest on record, considerable quantities being marketed from the fields in Good Friday week.

Results.—The varieties as a whole have given better results this year than last year. It is interesting to note that those varieties which stood out well in 1924 again gave a demonstration of their merits. The W. Y. Price strain, although eclipsed on the present occasion by two other sorts, has maintained a good position, as also have Mr. Temple's strain, Clucas' Early Market, and McEwan's Early. Mr. F. Lowrison's strain and Toogood's Nonesuch were noteworthy for their evenness, size and quality. That there are other good kinds the tabulated results show. The latter are based on counts and the valuation of independent valuers at each centre. Although the two centres had their own valuers it is interesting to note confirmatory valuations especially in respect to the leading varieties. Where discrepancies occur, it will be found mainly in respect to some of the small-hearted type such as "Early Wonder," Smurthwaite's strain, and Mordue's strain (medium size). These were decidedly more forward at Wylam than at Morpeth.

Northumberland Spring Cabbage Trials, 1925.

Order of Position	Variety or Strain	Bolts: Morpeth §	Bolts: Wylam ‖	No. ready to cut June 3rd *: Morpeth	No. ready to cut June 3rd *: Wylam	Value: Per doz. ‡	Value: Morpeth Total	Value: Wylam Full † Crop	Value: Aver-age
							£ s. d.	£ s. d.	£ s. (
1	F. Lowrison's (Hepscott) Strain	–	2	132	149	2/6	1 7 6	1 8 0	1 7
2	Toogood's Nonesuch ...	3	–	108	146	2/3	1 0 3	1 6 0	1 3
3	W.Y. Price's (Morpeth) Strain	1	–	117	138	2/-	19 6	1 4 0	1 2
4	Temple's (Morpeth) Strain	–	–	125	123	2/-	1 0 10	1 2 0	1 1
5	Clucas' Early Market ...	–	–	108	114	2/3	1 0 3	1 0 0	1 0
6	McEwan's Early (Dobbie)	–	–	109	130	2/-	18 2	1 2 0	1 0
7	Beefheart (Carter's) ...	3	6	80	138	2/3	15 0	1 4 0	19
8	Yate's Evesham	1	–	130	92	1/9	18 11½	18 0	18
9	Offenham (Stoke's) ...	–	–	112	108	2/-	18 8	18 0	18
10	First and Best (Clucas') ..	1	3	92	133	2/-	15 4	1 0 0	17
11	Finney's Wonder	2	1	69	144	1/9	10 0¾	1 2 0	16
12	Smurthwaite's Strain ...	–	2	68	137	1/9	9 11	1 2 0	15 1
13	Johnson's Offenham ...	–	–	111	119	1/6	13 10½	18 0	15 1
14	Ord's (N. Shields) Strain ...	–	1	84	129	1/9	12 3	18 0	15
15	Mordue's (Wylam) Strain...	2	1	77	121	1/6	9 7½	1 0 0	14
16	Market Favourite (Finney)	–	1	70	122	1/6	8 9	1 0 0	14
17	Pringle's Imperial ...	1	–	96	116	1/9	14 0	14 0	14
18	Spring Beauty (Bath) ...	–	2	84	116	1/6	10 6	17 0	13
19	Harrison's Offenham ...	–	–	94	120	1/2	9 1⅔	18 0	13
20	Flower of Spring (Sutton's)	3	3	93	132	1/3	9 8½	17 0	13
21	Early Kent (Harrison's) ...	6	10	33	112	1/-	2 9	18 0	10
22	Ellam's Early (Ord) ...	4	17	52	120	1/-	4 4	15 0	9
23	Clarke's Triumph	7	15	53	90	1/6	6 7½	12 0	9
24	Carter's Springtide ...	18	12	37	88	-/9	2 3¾	13 0	7
25	Victoria (Harrison's) ...	54	30	50	77	1/3	5 2½	10 0	7

* Out of 220 plants at Morpeth and 180 at Wylam.
† This valuation included the number ready and all others.
‡ At Morpeth. § Out of 11,00. ‖ Out of 180.

Classification.—The external features of a cabbage offer little reliable material on which to base a classification or establish relationships. There is, moreover, considerable confusion as to what is meant by a certain name. The three "Offenhams" in the trial presented distinctive features as between one and the other, the Lincolnshire strain being specially distinct in its compact shape, medium size, and deep green colour, as compared with the larger and lighter coloured strains from the Midland and Western areas of England. "Ellam's Early" is quite distinct in its small size, and very early hearting qualities. Next in size in an upward trend are "Early Wonder," "Smurthwaite's strain," "Early Kent" and "Springtide." We then come to the medium to fairly

large Offenham strains, allied to which are many of the leading local strains—early Market, Early Evesham, and McEwan's Early. The growing of seed at different places throughout the British Isles will always render standardisation impossible. Soil, climate, and the human factor will always exert varying influences on the very susceptible constitution of a cabbage. It is at this juncture then that the value and importance of local trials can be emphasised. Nor should they be spasmodic in occurrence or final in effect. Practically every distinct geographical area should be steadily and continuously testing current varieties offered to the public. The economic value of the trials is enormous if one compares the returns of the different varieties or strains, and it is just as easy to grow a "winner" as a "loser."

* * * * * *

NON-RETURNABLE PACKAGES FOR APPLES.

It has frequently been suggested that a cheaper non-returnable package for apples, particularly cooking apples, is required. It is a simple enough matter to design ideal packages, but the cost is prohibitive. Enquiries have therefore been made by one of the writers into the present cost of packages of various shapes and sizes and made of various materials. The primary object of the enquiry was to ascertain the cheapest kind of package suitable for one and a-half bushels, but other packages have also been considered.

It is desirable that any such package should be suitable both for packing in an orderly manner and for simply filling in. The best method of packing high-grade apples is that which is known as the "diagonal pack" and, for reasons already given in a recent article* (in this *Journal* for June last). This necessitates a package which is approximately square in section across its length. Such a package may be filled either from the side or end and will give the correct height of pack automatically. The "ring pack" is also satisfactory for comparatively short distances and requires a circular package. In order that the same package may be used for lower grade apples, which are simply filled in, it should be tall in proportion to its width.

* This *Journal*, June, 1925—Apple Packing, by J. Stoddard, J. Turnbull and A. Whiting.

Bushel Box.—The cheapest material of which moderate quantities of the British Standard box can be made is imported timber cut in England and this can be obtained for 7½d. per set—sometimes less in the early summer. To this must be added 1d. for railway carriage and nails and ½d. for labour of making up. The total cost to the grower is thus 9d.

There is also on the market a bushel box made of veneer, which costs 9d. delivered (Fig. 4). As sent out in the past its shape has not been suitable for the diagonal pack, but it can be supplied at the same price with an internal measurement of 11½ in. by 11½ in. by 18 in., which gives a bushel capacity on the diagonal pack without any bulge. This shape is as suitable as the present shape for filling in.

Barrels.—Second-hand grape barrels, frequently known as kegs, and holding approximately a bushel and a-half, are largely used in the provincial markets—generally as returnable packages. The cost of new packages of this type is about 2s. 4d. Danish butter barrels (which are similarly used, though to a less extent) are about the same size and cost about 2s. 5d. to 2s. 7d. at the coopers in Denmark. This cost is made up of shaped heads and staves of Danish beech 1s. 8d., hoops 4d. and labour of assembling 4½d.

The cheapest method of making barrels here on a fair scale would be to purchase imported prepared heads and staves which would cost 1s. 3d. for 1½ bushel, 1s. 6½d. for 2 bushel and 1s. 8d. for 3 bushel size, all c.i.f. London. To these prices would have to be added railway carriage, cost of hoops and labour of assembling. Detailed enquiry has not been made into these, but in the country would probably bring the total cost up to fully 2s. for the 1½ bushel, 2s. 4d. to 2s. 6d. for the 2 bushel and about 2s. 9d. for the 3 bushel size.

Fibre barrels are considerably used, but cost 2s. 6½d., 3s. 4d. and 3s. 9d. for the sizes mentioned above. One firm of coopers produced a barrel made of plywood, which made an almost perfect package, but it was to cost about 2s. 7d. for the 2 bushel and 3s. 6d. for the 3 bushel size.

Wooden Case.—Various specifications have been worked out for a case to hold 1½ bus., and the lowest quotation that has been obtained is for English cut imported timber at 11d. per set. To this would have to be added at least 2d. for carriage, nails and making up, which brings the total cost up to 1s. 1d. This is for 5/16 in. sides, 2 in. by 9/16 in. battens and various thin ends. The tallest practicable shape is about 1 ft. square

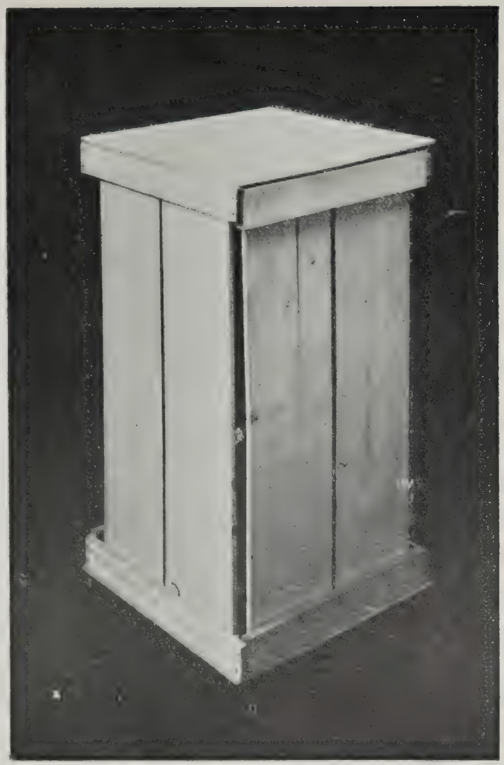

FIG. 1. —Wooden Case to hold $1\frac{1}{2}$ bushels.

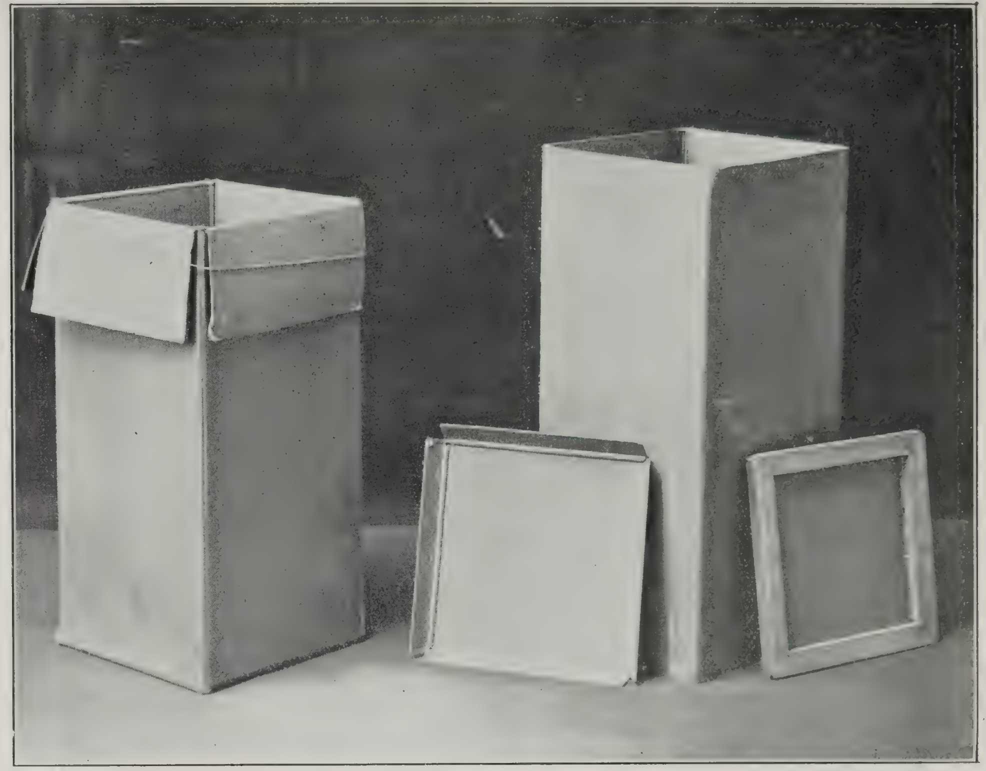

FIG. 2.—Waterproof Leatherboard Containers to hold $1\frac{1}{2}$ bushels.

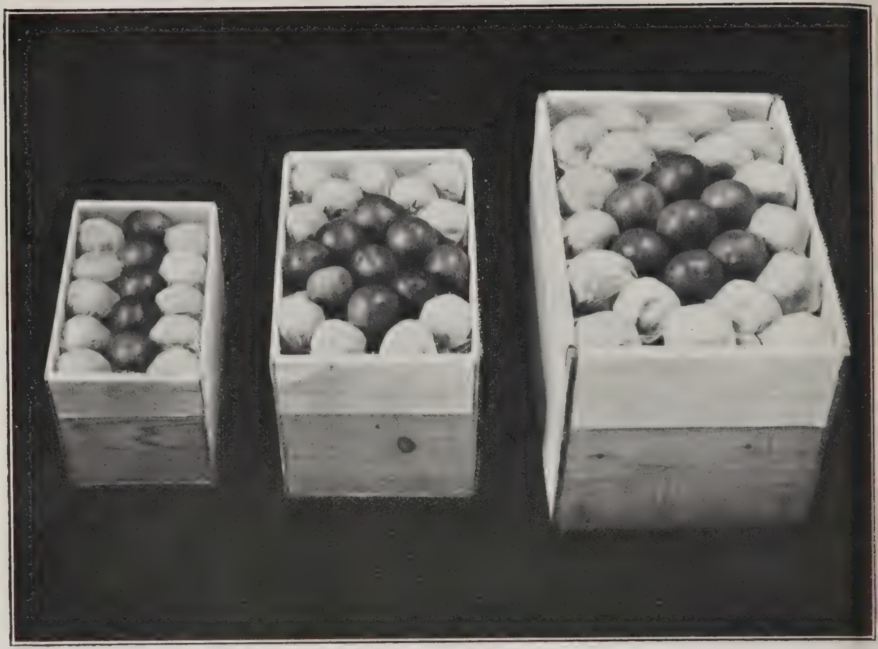

FIG. 3.—Wooden Boxes. Left to right, $\frac{1}{4}$ box ; $\frac{1}{2}$ box, and bushel box.

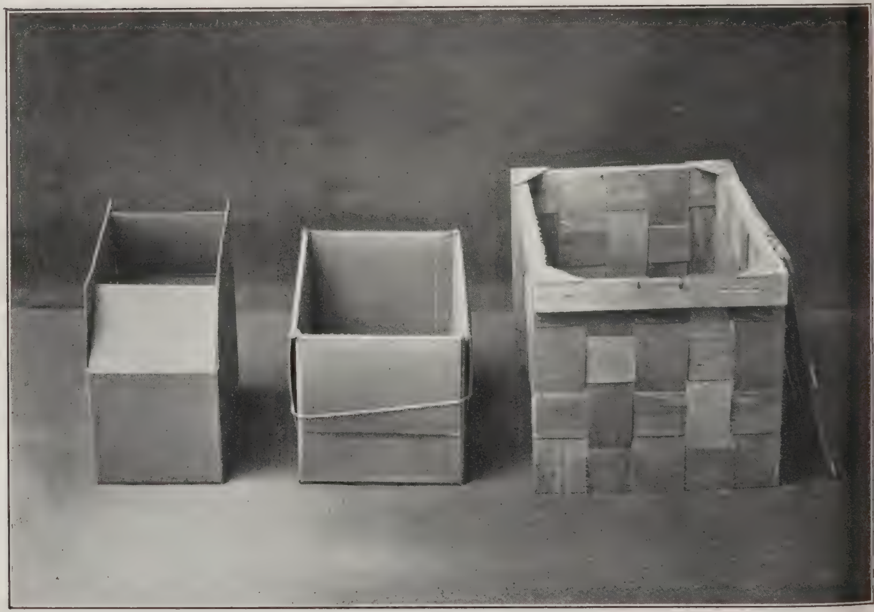

FIG. 4.—Left to right, $\frac{1}{4}$ box in fibre-board ; $\frac{1}{2}$ box in fibre-board, and bushel box in veneer.

and 2 ft. high. With 5/16 in. sides of this height, there is a slight bulge. The ends may be nailed on the outside with battens, or without if plywood is used, as shown in Fig. 1. This has the advantage of making a very strong package. If it is desired to have an adjustable end, so as to be able to press it down and secure a tight pack, a thin end held in place by battens might be used, but they would give no strength to the package which would easily come apart. Thicker ends, which could be nailed into through the battens and sides would need to be at least 7/16 in. thick—which would add about 1d. to the cost. Experience with this type of package would probably show that the best shape would be 14 in. square and 18 in. high.

The possibility of reducing the cost of this package by using thick veneer as seen in some American packages has been considered, but apparently the cost of the knotless wood required would be prohibitive in this country.

Manufactured Boards.—Best quality waterproof leather-board, known as containerboard, costs about £17 10s. per ton. About 5 lb. is required to make a $1\frac{1}{2}$ bus. package, and the cost of material would be over 10d. (after allowing for waste in cutting). Expensive machinery is also required for cutting, folding and stitching. The quotation for a complete package is 1s. 3d. to 1s. 5d. delivered.

There is a cheaper class of material known as fibreboard. Rectangular packages made from this are shown in Fig. 2. The type with turned back ends costs from 9d. to $9\frac{3}{4}$d. delivered, to which must be added cost of gluing $\frac{1}{2}$d., making a total of $9\frac{1}{2}$d. to $10\frac{1}{4}$d., according to quantity. The type with wood frame end, also shown in Fig. 2, costs $11\frac{3}{4}$d. to 1s. $0\frac{3}{4}$d., plus nails and labour $\frac{3}{4}$d., total 1s. $0\frac{1}{2}$d. to 1s. $1\frac{1}{2}$d., or about the same as an all wood case. Instead of the wood frame ends, fibre-board ends as shown might be used. The cost would then be $9\frac{1}{2}$d. to $10\frac{1}{4}$d. plus $\frac{1}{2}$d. for stitching, making a total of 10d. to $10\frac{3}{4}$d. In this case a good stitching machine costing £10 would be required, as the boards are thick and it requires considerable pressure to pierce them.

These seem to be the cheapest packages available and owing to their light weight, the saving in railway carriage is considerable, but trial is necessary to ascertain whether they are strong enough to protect the contents and withstand rough usage—and also whether they meet with approval in the market.

Cylindrical Packages.—These might conveniently be made out of manufactured boards or plywood. It is understood that the "drum" used for Canary bananas, which is made of container boards with wood frame ends, costs as much as a wooden package and is used for technical reasons which do not apply to our apples. This is borne out by the costs of rectangular packages given above. It is possible that the cost of this package might be lowered by making it entirely of fibre-board, but machinery does not seem to be available for making suitable one piece ends in such a large size.

Third quality thin plywood costs 10s. 6d. per square and is generally sent in pieces 5 ft square. Sufficient for a 1½ bus. package would cost 1s. 3d. or 1s. 4d., to which must be added 2d. or 3d. for making up with bands and nails. Rejected material may be obtained at a cheaper rate, but it would not have to cost more than half of this to be worth considering.

1½ Bushel Packages.—The following is a summary of the cost of the various packages considered:—

Package.	Weight.	Price.	Extras.	Total.	Cost per bushel.
	lb.	s. d.	d.	s. d.	s. d.
Barrel Wood	14	1 3	9	2 0	1 4½
,, Fibre	—	2 6½	...	...	1 8½
,, Plywood (2 bus.) ...	—	2 7	...	...	1 3½
Case Container board ...	5	0 10	6	1 4	0 10½
,, Fireboard and wood	5	1 0	¾	1 0¾	0 8¾
,, ,, fibre ends ...	4	0 10	½	0 10½	0 7
,, ,, one piece ...	5	0 10¼	½	0 10¾	0 7¼
,, ,, (in quantity)	—	0 9½	½	0 10	0 6¾

It appears from the above that the cheapest package is made entirely of fibreboard. It has the advantages of being light, collapsible and pilferproof. Packages made from similar material were tried many years ago and failed, but the design and method of making up (on which the strength largely depends) were different. Nothing but trial will decide whether they are suitable or not, and they will be tried during the coming season.

Next to these the cheapest 1½ bus. package is the sawn wood case. Even this costs as much in proportion as the bushel boxes first mentioned.

Half Box.—High-class dessert apples such as Cox's Orange Pippin, of grades not quite good enough for single layer boxes require a smaller package than the British Standard Box. A

half bushel box suitable for packing diagonally should be 9 in. by 9 in. by $14\frac{1}{2}$ in. inside. A wooden box to the following specification :—

Ends	2 pieces	9 in. x 9 in. x 7/16 in.
Top, bottom and sides	8 ,,	$15\frac{3}{8}$ in. x $4\frac{1}{2}$ in. x 3/16 in.
Battens	4 ,,	$8\frac{3}{4}$ in. x $\frac{3}{4}$ in. x 3/16 in.

costs about 5d. plus $\frac{3}{4}$d. for carriage, nails and making up: total $5\frac{3}{4}$d. A box of similar size and shape may be made of fibreboard, and would cost $4\frac{1}{2}$d. to 5d. plus $\frac{1}{2}$d. for gluing: total 5d. to $5\frac{1}{2}$d. according to quantity (Figs. 3 and 4).

Quarter Box.—This should be useful in developing the sale of packages intact or for direct trading. Such a box suitable for packing diagonally should be 7 in. by 7 in. by $12\frac{1}{2}$ in. inside. A wooden box to the following specification—

Ends	2 pieces	9 in. x 9 in. x 7/16 in.
Top, bottom and sides	8 ,,	$13\frac{3}{8}$ in. x $3\frac{3}{8}$ in. x 3/16 in.
Battens	4 ,,	$6\frac{3}{4}$ in. x $\frac{3}{4}$ in. x 3/16 in.

costs about $3\frac{3}{4}$d. plus $\frac{1}{4}$d. : total 4d. A fibreboard box of similar size and shape costs about $2\frac{1}{2}$d. to 3d. plus $\frac{1}{4}$d., total $2\frac{3}{4}$d. to $3\frac{1}{4}$d.

The tomato box is a cheaper box, costing only $2\frac{3}{4}$d. in the flat or $3\frac{1}{4}$d. made up (owing to the very large quantity made), but owing to its shape, it will only accommodate apples of 2 in. to $2\frac{1}{4}$ in. diameter on the diagonal pack.

* * * * * *

DEPOSITS OF ARSENIC AND COPPER ON EATING APPLES.

FRUIT growers now make a practice of spraying fruit trees with liquids containing poisonous chemicals, and those containing copper, arsenic and lead compounds are used quite frequently. In this country such sprays are applied when the blossoms are in the pink bud stage, and sometimes again immediately after the petals have fallen, and in some cases perhaps even a little later. In America, sprays are applied at similar times, but additional sprays are used and the last may be applied even 12 to 14 weeks after the blossoming stage. The growers find these sprays necessary to keep down pests, which, if allowed to develop, would blemish the fruits. The idea of using poisonous chemicals on fruit may appear to be unsafe, since fruit is eaten in the unwashed state and often unpeeled, and it is not surprising that many members of the

consuming public point to this matter and ask for assurances that harm cannot result. Frequently, anxiety has arisen where people have purchased imported apples and noticed in the depressions surrounding the eye and stalk of the apples a thin film of greenish powder—probably copper arsenate. Apples bearing these greenish deposits are now so common that some Members of Parliament have asked questions in the House of Commons as to the danger of using such sprays, and journalists have been stimulated to write condemnatory articles in the public and trade press.

An inquiry into the matter was therefore desirable, and the Ministry accordingly arranged for members of its horticultural inspectorate to purchase apples which were known to have come from three distinct and different sources:—(*a*) From English orchards; (*b*) from Canadian orchards; and (*c*) from American orchards. It was known that spraying had been done in the English orchard but there was no information available to show whether sprays had been used in the other orchards.

The samples, numbering 24 in all, and each consisting of about five apples, were tabulated separately and submitted to Sir R. Robertson, the Government chemist, for analysis, with the results shown in the following table.

Sir R. Robertson reports that for the purpose of analysis the flesh of the apples was rejected, and the examination confined to skin, stalk and calyx, since previous work had shown poisonous metals to be unrecognisable in the flesh of apples even when ponderable amounts were present on the skin.

Arsenic.—Eleven of the samples were free from arsenic, nine contained traces, and four contained proportions a chemist would consider to be appreciable. Only one of these four contained more than 1/100th grain per pound, the limit suggested by the Royal Commission on Arsenical Poisoning in 1903, the actual proportion found in this sample being equivalent to 1/55th grain of arsenious oxide in a pound of apples. The medicinal dose of arsenic given in the British Pharmacopœia, 1914, is 1/64th to 1/16th of a grain. A consumer of such exceptional apples would therefore have to eat more than $\frac{1}{2}$ lb., including peel, stalk and calyx to get a minimum pharmacopœial dose, and about $2\frac{1}{2}$ lb. to get a maximum pharmacopœial dose.

LEAD, COPPER AND ARSENIC ON APPLES BOUGHT BY THE MINISTRY.

No.	Source.	Total found on surface per pound of apples.		
		Lead Grains.	Copper Grains.	Arsenic Grains.
1	Devon	0.0004	none	none
2	Nova Scotia	0.0007	none	trace
3	U.S.A.	0.0003	none	trace
4	Nova Scotia	0.0004	0.0024	trace
5	U.S.A.	0.0022	0.0017	0.0009
6	U.S.A.	0.0057	trace	0.0035
7	U.S.A.	0.0007	0.0014	0.0019
8	Canada	0.0009	0.0025	none
9	British Columbia	0.0007	0.0007	none
10	British Columbia	0.0349	0.0006	0.0182
11	Nova Scotia	0.0004	0.0011	none
12	Lancashire	0.0003	0.0015	none
13	Not stated	0.0011	0.0046	none
14	Purchase at Capel Curig	0,0037	0.0084	trace
15	Yorkshire	0.0010	0.0027	trace
16	Not stated	0.0006	0.0035	trace
17	Worcester	0.0003	none	none
18	Kent	0.0001	none	none
19	Cambridge	trace	0.0016	trace
20	Cambridge	none	0.0005	none
21	Cambridge	none	0.0010	trace
22	Cambridge	0.0002	none	trace
23	Cambridge	0.0002	none	none
24	Devon	0.0010	0.0027	none
	Average	0.0023	0.0015	0.0010

If the apples were eaten with their skins on but without the calyx, stalk and the small amount of peel near them, then these weights of apples would need to be doubled to get the respective pharmacopœial doses, since it was shown that one-half the total arsenic was localised around the stalk and calyx.

It may be of interest to compare the following maxima expressed as decimal fractions of a grain of arsenious oxide per pound of material, and found—

Upon the apples mentioned above	0.018
In Whitstable eating oyster meats ("Fishery Investigations," Series II, Vol VI, No. 4. 1924, p. 48)	0.025
In the edible part of plaice ("Analyst," 1925, p. 10)	0.021

Lead.—Two lots of apples were entirely free from lead; one contained a trace that could be recognised but scarcely determined quantitatively; and twenty contained measurable though minute quantities ranging from 0.0001 to 0.0057 grain expressed as metallic lead in a pound of apples. The sample which was exceptional in its arsenic content was also exceptional in its lead content: the proportion being 0.0349 grain per pound. About 16 lb. of apples would have to be consumed, with skin, stalk and calyx, before a minimum pharmacopœial dose of lead would be taken.

Copper.—Seven lots of apples afforded no evidence of copper, but traces were found in the other samples. The maximum proportion was 0.0084 grain expressed as metallic copper in a pound of apples. According to Winter Blyth ("Poisons," p. 640) the ordinary daily food of an average man contains about 0.015 grain expressed as metallic copper, a quantity which would be found upon 1¾ lb. of apples like the sample containing the most copper.

Home-grown and Imported Apples.—It is a matter for serious consideration whether the home-grown apples which have been sprayed not later than May bore as much of the chemicals as those grown in the districts in the Pacific Coastal Regions of North America where spraying may be carried out as late as August. In all, 13 samples of home-grown apples were collected from orchards which had been sprayed with arsenate of lead twice (once in April and again in late May) in nine cases, and once only in two others, no information being available in regard to the remaining two. The average quantities found on the surface per lb. of apples were—

Lead *Grains.*	*Copper* *Grains.*	*Arsenic* *Grains.*
0.0004	0.0014	trace

In fact no arsenic was found on 8 of the samples and only a trace on the other 5. The amount of lead and copper present is too small to cause any anxiety, but it is somewhat curious to find copper present, since inquiries did not show that any copper spray had been used.

Eleven samples of apples grown in North America were found to bear lead, copper and arsenic on the surface, per lb. of apples, as follows:—

	Lead *Grains.*	*Copper* *Grains.*	*Arsenic* *Grains.*
U.S.A. (5 samples)	0.0025	0.0023	0.0013
Canada (6 samples)	0.0063	0.0012	0.003

Though these amounts are larger than those found on the home-grown fruit they are still too small to cause any anxiety. The average figures for the Canadian-grown apples probably give a wrong impression, for in five cases the amounts were very low but in the case of some "Jonathans" from British Columbia they were unduly high, probably indicating that the spraying there took place at a later stage when the apples were well developed and that no rains came later to wash the fruit before it was gathered. It is evident from this one case alone that apple growers may have to give up the abnormally late spraying or use some less obnoxious poison than the stable lead arsenate.

The results of the other twenty-three cases show that the total amounts of arsenic, lead and copper present were too small to be regarded as harmful even though the whole of the apples had been eaten.

* * * * * *

SEPTEMBER ON THE FARM.

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Weather Notes.—September is the first month of the autumn quarter; its normal weather characteristics, however, resemble those of summer rather than those of the next two months. The day temperature in the Midlands generally rises to about 65° F., and the mean night temperature is about 52° F.; but towards Michaelmas night frosts begin to occur in most districts, showing their effects on the more sensitive plants, such as nasturtiums, runner-beans and potatoes; and the evening mists hanging over low-lying grass fields serve to remind the farmer about the husk worm, which may affect his young stock if still lying out at night on such land. The normal rainfall in September is comparatively low; but occasionally, as in 1918 and no longer ago than last year, this may be a cloudy, wet month, during which corn sheaves dry tardily and stubble cleaning is impossible on any but light soils.

Field Operations.—Harvest work commonly extends past the middle of September, and later in upland and northern districts. Here the corn frequently is unripe at the end of the month, and when cut while still green and sappy, it is allowed to complete its drying by being left in the field in small conical stacks. This year appearances point to the possibility of the hill corn crops attaining yellow ripeness, which is an advantage in that ripe

corn can be secured with less difficulty than green grain. More use might, however, be made of the proved early ripening sorts of oats, such as Dala and Superb, and of the fact that winter oats can be grown successfully to ripen in August at high altitudes, if sown in January and February.

Hedges between arable fields are properly kept short and, of course, clean and free from weeds in the bottom. The requisite thorough bottom cleaning is generally done when the field is under fallow crops, attention being given to the headlands and hedge bottoms as soon as possible after the root crop has been singled and horse hoed. The annual brushing of the hedges is often conveniently done immediately after corn harvest. At this time the thorn is still in full leaf, when the shoots are easier to cut than they are after the sap has gone. It cannot be denied, however, that repeated cutting in August or September tends to weaken the growth of the quick.

The correct order of attention to the different sections of the arable land in September depends on the actual rotation of crops practised. Where little autumn-sown corn is grown, operations may be concentrated on cleaning and perhaps manuring the stubbles intended for green crops next year. Where winter corn is sown, however, priority is properly given to the preparations necessary for drilling the crops which should be sown in October, such as winter beans, winter oats, and wheat after "seeds" and bare fallow.

Wheat.—Provided that the seed bed has been suitably prepared and that excess of seed is not used, early sowing is an important factor in the production of good crops of wheat. The influence of time of sowing is illustrated in a very clear and interesting fashion at Reading, where for some years Professor Percival has sown a row of wheat every week in succession throughout the year. The plants sown in May and June do not produce ears until June of the next year; July and August sowings behave similarly; the rows sown in September and October, however, show stronger growth and better heads than those sown earlier or later. In the rows sown after the end of October there is a progressive decline in the vigour and ear-forming power of the plants until, in the April and later sowings, merely leafy growth continues for the remainder of the summer. Incidentally, other experimenters have found that if spring oats or barley be intersown with wheat in May, the wheat will behave like rye grass, heading out in June of the following year.

Early sowing is possible after bare-fallow, of which there were 462,800 acres in England and Wales on 4th June of the present

year. After bare-fallow, early sowing is desirable not only because it conduces to a full yield and allows of the saving of about 4 stones of seed per acre, but also because in this case delay may result in the land becoming too sodden to carry the teams at drilling. A period much favoured for the drilling is between 20th September and 1st October; but in some districts even earlier sowing may be practised. The chief risk with very early sowing is that in a mild winter the crop may become " winter proud ", the effects of which are most visible when too much seed has been used. Bunt or stinking smut is also most troublesome in early-sown crops, but this may be effectively and very cheaply prevented by dressing the seed with formalin solution. As a rule wheat after fallow is a safe crop; but recent investigation has shown that the wheat bulb fly results in considerable loss of plant during the winter in some districts. Land that has been bare fallowed is apt to lie rather wet at the surface during the winter, especially where the surface is level and too fine a tilth has been made. Rounded lands and a somewhat cloddy surface facilitate drainage and thereby prevent loss of plant by drowning and throwing out by frost. As regards varieties, stiff strawed sorts such as Yeoman, Iron and even Rivett's may be chosen with advantage, the first where quality pays, and one of the other two where, as in many districts, poultry corn is worth more than wheat of good milling quality.

Where wheat follows lea, early sowing is not as a rule practicable. The lea furrow requires a period of several weeks in which the turf may decay and the soil become mellowed and sufficiently moistened for the proper germination and development of the wheat. The grass should first be well grazed down and the furrows either heavily rolled or furrow pressed to obtain the necessary consolidation. Where the lea is in any degree infested with twitch, however, the surface layer must be skimmed off and worked out before ploughing. The latter method is much practised where the lea cannot be ploughed until September; but, as recent work on the frit fly has shown, there is risk attached to the sowing of corn in autumn after grassy leas which have not been ploughed before this month. Cases are on record of good results having been obtained where the lea stubble has been skimmed off, worked out and carried away, and the wheat drilled in the shallow mould without reploughing.

Most of the above remarks apply equally to winter oats. White winters possess very strong straw and exceptionally heavy

cropping powers on land in good heart. In the winter of 1923-24, however, this variety failed badly in the midland and northern counties. One of the most successful crops, in a district where failure was general, had the advantage of being drilled on 25th September.

Stubble Cultivations.—On feeding farms the consolidated manure is left undisturbed in the fold yards until about this time of the year, when it is carted out and applied to the leas for wheat or to the stubbles for mangolds or potatoes. Manure carting and stubble cleaning both demand attention at the same time, and as the former occupies most of the men and horses, the assistance of a tractor tilling outfit is particularly valuable at this period.

Where potatoes occupy a regular place in the rotation between two corn crops, as in the Lothian six-course (turnips, barley, seeds, oats, potatoes, wheat), attention is first given to the oat stubble: the wheat stubble after potatoes is clean, whereas the oat stubble after seeds may contain some twitch. In the Lothians the yard manure is applied in autumn to the oat stubble for potatoes, and the manner of its application is worthy of mention. The field is first marked out in both directions with scratch lines 5½ yards apart, forming squares of pole area, *i.e.*, 160 per acre. Each load of manure is then divided into the appropriate number of heaps, one heap per square. Thus in a 20-load dressing, each load must cover $160 \div 20 = 8$ squares. The marks also indicate the position of the ridges and furrows in the subsequent ploughing.

In the five-course rotation (roots, corn, lea, oats, wheat), it is sometimes difficult to decide whether to give first attention to the oat stubble or to the wheat stubble. The latter naturally contains most twitch; but if the oat stubble is to receive the requisite cleaning and manuring which good husbandry prescribes for a second straw crop, it must have early attention. The decision should depend on the land and on the crop intended. Where mangolds form part of the root break and the soil is heavy, probably the area intended for this crop should be dealt with first: mangolds are very intolerant of spring cleaning operations on heavy soil, and the crop is most reliable where the oat stubble has been cleaned and manured in autumn. Where ridge cultivation is practised, the ridges may be drawn out at this time of the year. The rest of the root break—for swedes, marrow-stem kale and cabbages—may well wait until the oat stubble has been prepared for wheat.

Live Stock.—September is the time when arable farmers begin to buy their winter stock of cattle and sheep to consume their roots and to tread down their straw. With light crops of roots and a shorter supply of straw, it is anticipated that the demand and the prices for stores will be correspondingly less than usual. Grass farmers who have land and fences suitable for sheep will doubtless consider the situation with a view to keeping a small flock of hoggs or a flying flock of ewes. There is no class of stock that has paid better in recent years than sheep well managed in winter on grass farms.

Milk Yields.—Notwithstanding the more skilful management required by high yielding cows, a herd average of 1,000 gallons of milk with a good fat content is the ideal after which the progressive dairy farmer is striving. Not many have attained it and succeeded in maintaining it for more than two years, and few if any can claim to have gained that measure of success with a home-bred herd of regular ages. Indeed, of the 138,984 cows officially recorded in the year ended 1st October, 1924, only 77 appear in the list of cows with Certificates of Merit in the Ministry's Register of Dairy Cattle (Vol. VIII), the qualification for the certificate being an output of 24,000-26,000 lb. of milk, according to breed, in three successive years, and not less than three calvings within the period.

It is obvious that a high milk yield involves the consumption of a correspondingly large quantity of foods; but there is ample evidence from actual experiments and ration records that abundant food or infinite care in feeding will not make up for the lack of an efficient udder: the first requisite is a cow possessing not only sufficient digestive capacity but also the necessary dairy temperament and milk manufacturing organs. "You can feed a cow until she bursts, but she will not make milk unless she has the inheritance for doing it." The desired type of cow is the product of parents which possessed active or latent dairy qualities. The milk-recording movement has for its object the encouragement of dairy farmers to breed from parents whose milk-producing ancestry has been demonstrated by actual measurement. The growing recognition of the value of the movement is indicated by the fact that during the year reviewed in Vol. VIII of the Annual Register, the number of members of milk recording societies increased by 401 and that 10,294 more cows were recorded than in the previous year. The next recording period begins on 1st October.

MONTHLY NOTES ON FEEDING STUFFS.

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The Use of Cocoa Shell Meal as a Feeding Stuff.—Quantities of cocoa shell meal are now reaching the market, and are being used as a feeding stuff for cows. A few remarks on the value of this material as a feeding stuff may be of value to farmers who wish to use it.

The fruit of the cocoa tree consists of a large pod, the interior of which contains a pulp in which are embedded 20 to 40 cocoa beans. These beans undergo a fermentation process, are heated to a high temperature, and by means of suitable machinery the kernel of the bean is separated from the shell. The outer husk or shell constitutes the by-product from which the cocoa shell meal is made. The feeding value of the cocoa shell meal varies with the treatment the bean receives during the preliminary treatments of fermentation and roasting, and it is therefore difficult to assess exactly the feeding value of different samples of cocoa shell meal. Cocoa shell meal is dark brown in colour, and is variable in composition. Available analyses show the following variations in composition:—Protein, 8.04 to 13.24 per cent.; fat, 2.8 to 8.6 per cent. (average about 3 per cent.); carbohydrates, 35.53 to 51.30 per cent.; woody fibre, 9.6 to 17.70 per cent.; and ash, 4.9 to 10.04 per cent. High ash content is associated with the use of an argillaceous earth in the preliminary preparative treatment of the bean. The ash contains a fair quantity of phosphorus and is particularly rich in potash and magnesium.

The differences in composition are also associated with differences in digestibility, the digestibility of the protein varying from 11 to 40 per cent. Two alkaloids are present in cocoa shell meal, theobromine and caffeine, the theobromine being present to the extent of 0.9 per cent. and the caffeine 0.5 per cent.

For Horses.—The presence of these alkaloids necessitates care in the use of the meal for stock feeding, and experiments in France during the war showed that it was inadvisable to give to horses more than 1¼ lb. of the meal per head per day, if untoward symptoms were to be avoided.

For Cows.—Experiments carried out with milch cows in Italy indicated that 2 to 6 lb. of cocoa shells may be given per head per day with useful results. Up to 10 lb. per head

DESCRIPTION.	Price per Qr. s. d.	lb.	Price per Ton. £ s.	Manurial Value per Ton. £ s.	Cost of Food Value per Ton. £ s.	Starch Equiv. per 100 lb.	Price per Unit Starch Equiv. s.	Price per lb. Starch Equiv. d.	Per cent of Digest. Crude Protein %.
Wheat, British	—	—	12 5	0 14	11 11	71·6	3/3	1·74	10·2
Barley, British Feeding	—	—	10 5	0 11	9 14	71	2/9	1·47	6·5
" Canadian :—									
" " No. 4 Western	40/6	400	11 7	0 11	10 16	71	3/1	1·65	6·5
" American	40/6	"	11 7	0 11	10 16	71	3/1	1·65	6·5
" Karachi	39/9	"	11 3	0 11	10 12	71	3/0	1·61	6·5
Oats, English, White	—	—	11 0	0 12	10 8	59·5	3/6	1·87	8·0
" " Black and Grey	—	—	10 10†	0 12	9 18	59·5	3/4	1·78	8·0
" Canadian :—									
No. 2 Western	33/6	320	11 15	0 12	11 3	59·5	3/9	2·01	8·0
" " Feed	27/3	"	9 10	0 12	8 18	59·5	3/0	1·61	8·0
" " Argentine	28/3	"	9 18	0 12	9 6	59·5	3/2	1·70	8·0
" " Chilian	27/9	"	9 15	0 12	9 3	59·5	3/1	1·65	8·0
Maize, Argentine	46/9	480	10 18	0 12	10 6	81	2/7	1·38	7·1
Beans, English Winter	—	—	12 0†	1 9	10 11	67	3/2	1·70	20·1
" Chinese "	—	—	11 2*	1 9	9 13	67	2/11	1·56	20·1
Peas, Japanese	—	—	26 0*	1 5	24 15	69	7/2	3·84	19·4
Dari, Egyptian	—	—	11 15	0 14	11 1	75·2	2/11	1·56	7·7
Millers' Offals :—									
Bran, British	—	—	7 2	1 4	5 18	45	2/7	1·38	10·9
" Broad	—	—	8 15	1 4	7 11	45	3/4	1·78	10·9
Middlings—									
Fine Imported	—	—	9 17	1 0	8 17	72	2/6	1·34	12·6
Coarse, British	—	—	8 7	1 0	7 7	64	2/4	1·25	11·5
Pollards, Imported	—	—	7 10	1 4	6 6	60	2/1	1·12	11·6
Meal, Barley	—	—	12 5	0 11	11 14	71	3/4	1·78	6·5
" Maize	—	—	11 15	0 12	11 3	81	2/9	1·47	7·1
" " South African	—	—	10 0	0 12	9 8	81	2/4	1·25	7·1
" " Germ	—	—	9 15	0 17	8 18	85·3	2/1	1·12	18·4
" " Gluten Feed	—	—	10 0	1 5	8 15	75·6	2/4	1·25	20·0
" Locust Bean	—	—	9 15	0 8	9 7	71·4	2/6	1·34	4·0
" Bean	—	—	13 0	1 9	11 11	67	3/1	1·65	20·1
" Fish	—	—	20 10	3 17	16 13	53	6/3	3·35	50·0
Linseed	—	—	22 5	1 8	20 17	119	3/6	1·87	19·4
" Cake, English 12% Oil	—	—	14 5	1 15	12 10	74	3/5	1·83	25·3
" " 10% Oil	—	—	13 7	1 15	11 12	74	3/2	1·70	25·3
" " 9% Oil	—	—	13 5	1 15	11 10	74	3/1	1·65	25·3
Soya Bean " 6 % Oil	—	—	12 10	2 8	10 2	69	2/11	1·56	38·2
Cottonseed Cake, English 5½% Oil	—	—	8 5	1 12	6 13	42	3/2	1·70	17·6
" " Egyptian 5½% Oil	—	—	7 17	1 12	6 5	42	3/0	1·61	17·6
Decorticated Cotton Seed Cake 7% Oil	—	—	12 17†	2 9	10 8	71	2/11	1·56	34·6
" " Meal 7% Oil	—	—	12 12†	2 9	10 3	74	2/9	1·47	36.3
Ground Nut Cake 7% Oil	—	—	10 15†	1 13	9 2	56·8	3/2	1·70	27·7
Decorticated Ground Nut Cake 7% Oil	—	—	13 10†	2 10	11 0	73	3/0	1·61	42·0
Palm Kernel Cake 6% Oil	—	—	8 15	1 1	7 14	75	2/1	1·12	17·1
" " Meal 2% Oil	—	—	7 15	1 2	6 13	71·3	1/10	0·98	17·1
Feeding Treacle	—	—	7 2	0 8	6 14	51	2/8	1·43	1·1
Brewers' Grains :—									
Dried Ale	—	—	8 17	1 2	7 15	49	3/2	1·70	14·0
" Porter	—	—	8 7	1 2	7 5	49	3/0	1·61	14·0
Wet Ale	—	—	1 5	0 8	0 17	15	1/1	0·58	4.8
" Porter	—	—	1 0	0 8	0 12	15	–/10	0·45	4·8
Malt Culms	—	—	7 15†	1 11	6 4	43	2/11	1·56	19·9

* At Liverpool. † At Bristol

NOTE.—The prices quoted above represent the average prices at which actual wholesale transactions have taken e in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage dealers' commission. Buyers can, however, easily compare the relative prices of the feeding stuffs on offer at their local et by the method of calculation used in these notes. Thus, suppose palm kernel cake is offered locally at £10 per ton. nanurial value is £1 3s. per ton. The food value per ton is therefore £8 17s. per ton. Dividing this figure by 75, the h equivalent of palm kernel cake as given in the table, the cost per unit of starch equivalent is 2s. 4d. Dividing this by 22·4, the number of pounds of starch equivalent in 1 unit, the cost per lb. of starch equivalent is 1·25d. A similar ulation will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the ts of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own et. The manurial value per ton figures are calculated on the basis of the following unit prices:—N, 11s. 7d ; P_2O_5, l. ; K_2O, 2s. 9d.

per day have also been given with favourable results in France. Careful experiments were carried out on this material by M. Lucas at Gournay Farm. In these experiments roughly 6 lb. of cocoa shells replaced 4½ lb. of grain, with the result that although the total yield of milk decreased in those animals fed on the cocoa shells, the total butter fat yielded was the same, since the decrease in total yield was associated with an increased percentage of butter fat.

For Sheep.—French experience has shown most favourable results with cocoa shell meal when it is fed to sheep. It is best fed mixed with forage in the proportion of ½ lb. of meal per head per day.

According to the above experiences with the use of cocoa shell meal as a feeding stuff, the following maximum amounts per head per day may be recommended. Horses, 1¼ lb.; cows, 6 lb.; sheep, ½ lb.

Valuation of Cocoa Shell Meal.—Owing to the differences, both in composition and in digestibility, it is difficult to assess or value cocoa shell meal. Kellner, from his experiments, assessed the feeding value of cocoa shells as equal to straw. Lindsey and Smith in America considered cocoa shells to be worth about half the price of maize meal, whereas the French experience quoted above would indicate that 2 tons of cocoa shells are equivalent in feeding value to 1½ tons of grain. Diverse though these opinions are, they are given here as some sort of guide to the farmer whc contemplates using this material for feeding his cattle.

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FARM VALUES.

CROPS.	Market Value per lb. S.E. d.	Value per unit S.E. s. d.	Starch Equivalent per 100 lb.	Food Value per Ton. £ s.	Manurial Value per Ton. £ s.	Value per Ton on Farm. £ s.
Wheat	1·38	2 7	71·6	9 5	0 14	9 19
Oats	1·38	2 7	59·5	7 14	0 12	8 6
Barley	1·38	2 7	71·0	9 4	0 11	9 15
Potatoes	1·38	2 7	18·0	2 6	0 3	2 9
Swedes	1·38	2 7	7·0	0 18	0 2	1 0
Mangolds	1·38	2 7	6·0	0 15	0 2	0 17
Beans	1·38	2 7	67·0	8 13	1 9	10 2
Good Meadow Hay	1·70	3 2	31·0	4 18	0 13	5 11
Good Oat Straw	1·70	3 2	17·0	2 14	0 7	3 1
Good Clover Hay	1·70	3 2	32·0	5 1	0 19	6 0
Vetch and Oat Silage	1·56	2 11	14·0	2 1	0 7	2 8
Barley Straw	1·70	3 2	19·5	3 0	0 6	3 6
Wheat Straw	1·70	3 2	11·0	1 15	0 4	1 19
Bean Straw	1·70	3 2	19·0	3 0	0 9	3 9

PRICES OF ARTIFICIAL MANURES.

NOTE.—Unless otherwise stated, prices are for not less than 2-ton lots f.o.r. in towns named, and are net cash for prompt delivery.

DESCRIPTION	*Average Price per ton during week ending Aug. 12th.*				
	Bristol	Hull	L'pool	L'ndn	Cost per Unit at London
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½ per cent.)	13. 2	13. 0	12.10	12.15	16. 5
,, ,, Lime (N. 13 per cent.)	...	12.10	...	12.12	19. 5
Sulphate of Ammonia, neutral (N. 21.1 per cent.)	12. 5*	12. 5*	12. 5*	12. 5*	(N)11. 7
Kainit (Pot. 20 per cent.)	3. 2	3. 0	...	...	...
,, (Pot. 14 per cent.)	2.17	2.15	...	...	...
Muriate of Potash (Pot. 50 per cent.) ...	8. 5	7.10	...	...	...
Sulphate of Potash (Pot. 48 per cent.) ...	12.10	11.15	...	...	...
Basic Slag (T.P. 34 per cent.)	...	...	3. 0§	...	...
,, ,, (T.P. 30 per cent.)	3. 3§	...	...	2.15§	1.10
,, ,, (T.P. 28 per cent.)	2.10§	2. 5§	...	2.10§	1. 9
,, ,, (T.P. 26 per cent.)	2. 6§	2. 1§	...	2. 5§	1. 9
,, ,, (T.P. 24 per cent.)	...	1.17§	1.18§	...	...
Superphosphate (S.P. 35 per cent.) ...	...	...	...	3. 8	1.11
,, (S.P. 30 per cent.) ...	...	3. 2	...	3. 2	2. 1
Bone Meal (N. 3¾, T.P. 45 per cent.) ...	8.15	8. 5	7.17	8. 0	...
Steamed Bone Flour (N. ¾, T.P. 60-65 per cent.)	6. 2†	6.10†	6. 5	5.10	...
Fish Guano (N. 7½-8½, T.P. 16-20 per cent.)	...	...	13. 0	...	...

Abbreviations: N.=Nitrogen; S.P.=Soluble Phosphate; T.P.=Total Phosphate; Pot.=Potash.

* Delivered in 4-ton lots at purchaser's nearest railway station.

† Delivered (within a limited area) at purchaser's nearest railway station. London prices are for 4-ton lots.

§ Prices include cost of carriage from works to town named. Hull prices include delivery to any station in Yorkshire, Liverpool to any station in Lancashire and London prices are for not less than 4-ton lots delivered within a limited area. Cost to purchasers in other districts will be greater or less according to the distances of different purchasers from the works.

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MISCELLANEOUS NOTES.

Electro-Culture Investigations.

THE Electro-Culture Committee recently presented to the Minister of Agriculture its Seventh Interim Report, dealing with its work during 1924.* The work carried out by the Committee since 1918 has shown that under field experimental conditions an increased yield of 20 per cent. on the average may be expected when certain spring-sown cereals are subjected to high-tension electrical discharge, also that under both field and pot experiments electrification has accelerated repro-

* Copies of this Report can be obtained from the Secretary of the Committee, Mr J. H. Tabor, Ministry of Agriculture, 10, Whitehall Place, London, S.W.1.

ductive growth much more markedly than vegetative growth. The results obtained in 1922 from pot-culture experiments at Rothamsted Experimental Station were so striking that the Committee decided to discontinue temporarily the field work and to concentrate for a time on pot-culture, small plot and laboratory work with the object of ascertaining the most suitable periods and the most suitable hours of the day for the discharge. The results of the pot-culture and small plot experiments in 1923 confirmed the results of the pot-culture experiments of 1922, viz., that electrification of spring-sown cereals for one month may be more effective than electrification for the full time (June to August).

The programme of work for 1924 was confined to pot-culture and small plot experiments on the lines of those conducted in 1923, with the addition of investigations dealing with the effect of the discharge over smaller periods than one month, and the effect of varying the strength of the current, since no knowledge was available of the lower strengths of current that are effective.

At Rothamsted Experimental Station pot-culture experiments were conducted to test various durations and strengths of current. Goldthorpe Barley "pure line" was used, as in previous years. Sets of pots were subjected to moderate current for six hours daily during the first month, the second month, the third month, for "full time" (June to August) and for two weeks in the second month respectively, and one set to weak current for the full time. All the six sets of cultures showed increases of grain yield over that of the controls, though in none was the increase larger than 21 per cent. There was not much to choose between the yield of plants subjected to the discharge for the first month and for "full time," and taking the size of the probable errors into account, it is doubtful if there is any significant difference between the treatment for the three single months and for the "full time." The results confirmed those of 1922 and 1923 in showing that one month's electrification is as effective as a "full time" one, but it does not decide the question as to whether the first, second or third month is the most favourable, though the evidence appears to favour the first or second month.

It is very noticeable that in the electrified plants the increase in grain yield is relatively higher than that of total yield (straw plus grain). A relative decrease in total yield may even be associated with an increase in grain yield.

To test the effectiveness of the normal air-earth current, a small area at Rothamsted, as in the past three years, was surrounded by a " cage " (consisting of parallel " earthed " wires about 6 centimetres apart) in which plants in pot-culture grew under conditions in which they were to a large extent excluded from the influence of the air-earth current. In 1924 a second cage with additional potential was also employed. For the first time in four years the " caged " plant gave an increase over the " uncaged " control, but this increase was not significant. The effect of the small artificial atmosphere potential was positive but not by itself significant.

Small plot experiments were conducted at Rothamsted and Lincluden (Dumfries). In consequence of the damage by pests at the former station the results were of little value. At Lincluden small plots of oats were subjected to electrification for the first month only, the second month only, the third month only and for the " full time " (June to August). In agreement with last year's results treatment for a single month was as effective as treatment for " full time." As was the case in 1923 the first month was more effective than the second or third. The plot receiving current for the first month only gave an increase over its relative control of 1 per cent. total yield (straw plus grain) and of 51.6 per cent. grain yield, the second month plot gave a decrease of 4.1 per cent. total yield and an increase of 10.9 per cent. grain yield, the third month plot a decrease of 7.2 per cent. total yield and an increase of 33.2 per cent. grain yield, while the corresponding figures for the " full time " plot were + 6.0 per cent. and + 25.7 per cent. The increase in grain yield is substantial, especially in the case of the first month's electrification.

The experiments of the present year are again being confined to small scale work to deal with the following four questions :—

(1) Whether the 1st or 2nd month's electrification is more effective.
(2) Whether the 1st and 2nd or 2nd and 3rd month's electrification is more effective than electrification for a single month or for the whole season.
(3) The daily duration of discharge.
(4) The intensity of discharge.

Laboratory studies on the effect on growth of an ionization current in air artificially ionized by the use of a radio-active substance are being continued during 1925 at the Imperial College of Science and Technology, while, in addition, the plant is being studied to ascertain at what stage in its growth the current can most usefully be applied.

Fruit and Vegetable Marketing.

AN account of the activities of the Gloucestershire Fruit and Vegetable Co-operative Society, Ltd., was given in this *Journal* in April, 1924, page 68. The Society has recently published a pamphlet entitled "Sound Marketing," containing much good advice, from which the following notes have been summarised.

The pamphlet points out the importance of growers realising the part necessarily taken by others in their industry. The idea should be ruled out that one individual can only profit by the loss of another. Those concerned in the fruit and vegetable industry are the grower, the wholesale buyer, the retail seller and the consumer, and growers are urged to do nothing which will prevent the other branches from doing their best.

It is the grower's business to produce fruit and vegetables, and after his crops have reached maturity and have been gathered or harvested the main function of his business has ceased. After this, he must look for the real results of his labours to other hands. One thing, however, it is in his power to do, which forms the last link that binds him to the results of his labours, namely, to present his produce in the form that will be most acceptable to the wholesale buyer, the retail seller and the consumer. No market can be really styled a growers' market, they are all buyers' markets, and in them the buyer's point of view will ultimately prevail.

Confidence is the basis of all successful trading, and confidence is not earned in a day. Growers will try a market by sending a single consignment, with perhaps disappointing results. There will always be fluctuations of price, and the proper way to test a market is to patronise it for a season and thus get the confidence of the buyers, who will look out for a grower's produce on each succeeding market day. The grower who tries to follow the luck of two or three different markets never gets anywhere in the end, whereas he might be engaged in building up a solid reputation in one market.

It is quite natural that growers should desire to sell their produce in the best market, but it should also be remembered that a co-operative market, established largely by growers, belongs to them, and it is in their interest to support it and make it the best market in the district.

Packing, Grading and Guarantee.—Grading is incomplete unless some identifiable guarantee goes with the produce. A ticket saying: "This fruit was grown by John Smith," is

useless. There are thousands of John Smiths in the country, and how is the retailer, whom the guarantee mostly concerns, to know which is which? The Cheltenham market has introduced a scheme whereby every grower can have a number which cannot be duplicated and which is placed on every package of produce he sells. If he does not place a number label on each package, such package has in reality no guarantee, for the wholesaler will probably split up his purchase upon resale to his customers, who will therefore not be able to demand the same produce again, and the value of the guarantee is lost.

The two standard grades for apples and pears are as follows :—

First Grade.—Good, large (for the variety), clean, sound and shapely fruit.

Second Grade.—Fruit of both large and medium size, but slightly inferior to first grade as regards cleanness, soundness and shapeliness; as well as medium size fruit of first grade description.

The reason for the adoption of these gradings is that some buyers require a really all-round first-grade fruit while others do a second-grade trade, and these are the gradings which experience indicates as those most sought after by the buyers. It will be noticed that first grade corresponds with the grading of imported fruit, and if home-grown fruit is to compete with overseas fruit, quality must compete with quality, and incidentally, weight with weight.

"We wish to impress upon growers the value of careful packing. The aim should be to present the fruit to the buyers in as near a state of perfection as possible: there should be uniformity in size and colour, neatness and general good finish. Fruit of specially high quality will pay for any extra care and time spent in putting it up in an attractive manner. All containers should be lined with paper (white for preference) so as to overlap and cover the top of the fruit."

"In marketing soft fruits, over-ripeness is a thing to be avoided. It should be remembered that a considerable period may sometimes elapse before the fruit reaches the consumer. Pears especially should be on the firm side. Ripe fruit should not be put into large containers. Vegetables, as well as fruits, pay for care taken in packing. Much of the cauliflower and broccoli that comes into our markets is trimmed too closely and buyers complain of damage sustained in transit. A simple way to pack cabbages and greens in nets is to place the net in a pot basket so that the edges and tying cord hang over the rim of the pot basket all round. Fill the package well up

and over the top, pressing well into the bottom corners. Lace tightly, and the finished pack will turn out of the mould almost a perfect cube."

"In the days of the wicker empty, it was often customary to pack produce direct into the empty in the market-garden or the orchard. But it is clear that the non-returnable cannot be so used. Fruit and vegetables should be gathered in receptacles kept specially for this purpose and packed into the non-returnable under cover to ensure the packages leaving the grower in a clean and dry state."

"All packages which are provided with covers should arrive in the market closed, and after stacking the produce on the floor of the market, one package of each class should be left open for the buyer's inspection. This will give the buyer that confidence which will lead him to trust to the honesty of the grower to pack fairly throughout."

Containers.—The vexed question of returnable or non-returnable package does not exist in this Society's markets, for the returnable package has been eliminated by them, and a non-returnable container is provided for every form of produce. It is a matter of considerable interest that the Society has met with so much success in promoting the use of non-returnables.

Standardised Weights.—"Another valuable advantage which we hold out to buyers is standardised weights and packages, and it is possible to buy in packages ranging from 12 to 48 lb. contents with covers, thus eliminating pilferage in the market as well as in transit. This brings us to our latest reform—the introduction of a container with lid to hold 40 lb. net weight of apples, and 48 lb. net weight of hard pears and green plums. Up to the year 1924 the standard container for apples was a package to hold 56 lb. net weight and weighing 64 lb. gross. This weight is too heavy for careful handling, and the new 40 lb. package for apples has become so popular with our leading growers that we already look upon the 56 lb. container as a thing of the past."

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Farm Workers' Minimum Wages.

A MEETING of the Agricultural Wages Board was held on 21st July at 7, Whitehall Place, S.W.1, Mr. J. Willmot acting as Chairman in the absence of Lord Kenyon.

The Board considered a notification from the Hertfordshire Agricultural Wages Committee of a resolution fixing special minimum rates of wages for the corn harvest, and proceeded to make the neces-

sary Order carrying out the Committee's decision. The Order operates as from Monday, 27th July, and provides a special hourly rate of wages for all employment on the corn harvest in 1925, the rate in the case of male workers aged 21 and over being 10½d. per hour, and in that of female workers aged 21 and over, 7½d. per hour, less rates being fixed for younger workers.

Copies of the Order in full can be obtained on application to the Secretary of the Agricultural Wages Board.

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Farm Wages in Scotland.

THE Board of Agriculture for Scotland has now published particulars of the average wages paid to agricultural workers in every county of Scotland at Whitsuntide, 1925; for the purpose of the summary the country is divided into five divisions.

As compared with the similar statement issued in respect of Martinmas, 1924, it is observed that the wages of married men have fallen generally, the decrease being more marked in the northern part of the country than in the south. Thus, with certain exceptions, married ploughmen, cattlemen and shepherds have suffered decreases of from 1s. 2d. to 3s. 3d. per week in the N. and N.W. district (except in Harris, where wages have risen considerably); from 8d. to 3s. 11d per week in the N.E. district; and from 8d. to 4s. 10d. per week in the E.C. district. On the other hand, in the S.E., W. and S.W. districts increases ranging up to 3s. 6d. and 4s. 7d. respectively were received in some counties, although decreases of as much as 3s. 3d. and 1s. 8d. occurred in other counties.

Single ploughmen, on the contrary, generally received increases of wages, which ranged up to 7s. 8d. in the W. and S.W. district. In only one district—East Central—were any considerable decreases recorded, these amounting to as much as 9s. 5d. per week in one county.

The average wages which were being paid to married ploughmen at the time the return was compiled, were 33s. 11d. per week in the N. and N.W. division; 35s. 5d. in the N.E. division; 40s. 4d. in the E.C. division; 41s. 5d. in the S.E. division; and 40s. 3d. in the W. and S.W. division. The wages in the corresponding divisions in the case of single ploughmen were 31s., 36s. 5d., 37s. 5d., 35s. 10d. and 32s. 10d. per week respectively.

Number and Declared Value of Animals Living, for Breeding, Exported from Great Britain and Northern Ireland in the three months ended June, 1925, compared with the corresponding period in 1924.

(From Returns supplied by H.M. Customs and Excise.)

Country to which Exported	April to June, 1925		April to June, 1924	
	Number	Declared Value	Number	Declared Value
CATTLE		£		£
Argentina	210	48,000	189	28,400
Belgium	15	155	0	0
Columbia	5	501	0	0
Denmark	12	380	0	0
Germany	16	550	5	450
Japan	3	640	3	240
Uruguay	36	5,310	64	7,378
Irish Free State	1,999	25,622	2,924	34,575
Kenya Colony	9	455	3	200
Union of South Africa ...	40	3,192	0	0
Other Countries	14	1,370	10	706
Total of Cattle	2,359	86,175	3,198	71,949
SHEEP AND LAMBS				
Argentina	58	645	0	0
France	8	80	0	0
Germany	12	390	0	0
Japan	0	0	23	230
Morocco	0	0	6	101
Sweden	30	690	0	0
Irish Free State	328	750	64	378
Union of South Africa ...	15	264	0	0
Other Countries	3	62	9	159
Total of Sheep and Lambs	454	2,881	102	868
SWINE				
Argentina	5	92	11	540
Czecho-Slovakia	6	120	27	360
France	6	120	14	444
Germany	44	1,090	4	144
Italy	17	439	11	157
Japan	7	306	19	570
Netherlands	14	471	11	268
Ceylon	6	60	0	0
Irish Free State	118	583	129	241
Union of South Africa ...	59	1,254	0	0
Other Countries	15	228	5	92
Total of Swine	297	4,762	231	2,816

Scholarships for Agricultural Workers.

THE Ministry announces the following awards under the scheme of scholarships and maintenance grants for the sons and daughters of agricultural workmen and others:—

Class I (for three or four years at University Departments of Agriculture):—Frederick C. Bawden (Okehampton, Devon), Hubert R. Catchpole (Whitlingham, Norfolk), Robert F. Edwards (Castle Acre, Norfolk), Martha J. Graham (Brampton, Cumberland), William E. Gelling (Crosby, Isle of Man), Frederick W. Munnings (Sleaford, Lincolnshire), Audrey M. Polgreen (St. Germans, Cornwall), Edwin R. Wallace (Keswick, Cumberland), Kathleen Woolnough (Rayleigh, Essex).

Class II (for two years at an Agricultural College):—Charles E. Bland (Arundel, West Sussex), Charles V. Carter (Wellington, Salop), Stanley A. Child (Tawstock, Devon), John A. Evans (Carno, Montgomeryshire), Hilda M. Hatchwell (Newton Abbot, Devon), Norman P. Jones (Bethel, Carnarvon), Walter R. Penman (Ryton-on-Tyne, Durham), Mary A. Steel (Billingboro', Lincolnshire), Raymond Tamblyn (Scorrier, Cornwall), George Wells (Saxtead, Suffolk).

Class III.—111 scholarships have been awarded for short courses at Farm Institutes in agriculture, dairying, horticulture and poultry-keeping.

The number of applications for scholarships received was 493.

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International Conference of Agricultural Associations.

IN connection with the Swiss Agricultural Exhibition, an International Conference of Agricultural Associations will be held at Berne on 22nd and 23rd September next. The conference, to which the agricultural organisations of all countries are invited, is held for the purpose of examining the question of the constitution of an international organisation for the purpose of defending the common interests of agriculturists in international questions.

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AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1925.

ACREAGE UNDER CROPS AND GRASS AND NUMBERS OF LIVE STOCK ON HOLDINGS ABOVE ONE ACRE IN EXTENT IN ENGLAND AND WALES AS RETURNED BY OCCUPIERS ON 4TH JUNE, 1925.

(The figures for 1925 are subject to revision.)

CROPS AND GRASS.

DISTRIBUTION.	1925.	1924.	INCREASE.		DECREASE.	
	Acres.	*Acres.*	*Acres.*	*Per Cent.*	*Acres.*	*Per Cent.*
TOTAL ACREAGE under all CROPS and GRASS	25,755,000	25,877,000	—	—	122,000	*0·5*
*ROUGH GRAZINGS	5.028,000	4,946,000	82,000	*1·7*	—	—
ARABLE LAND	10.680,000	10,929,000	—	—	249,000	*2·3*
PERMANENT GRASS — For Hay ..	4,312,000	4,501,000	—	—	189,000	*4·2*
PERMANENT GRASS — Not for Hay ..	10.763.000	10,447,000	316,000	*3·0*	—	—
PERMANENT GRASS — TOTAL ..	15.075.000	14,948,000	127,000	*0·8*	—	—
Wheat	1,499,000	1,545,000	—	—	46,000	*3·0*
Barley	1.319,000	1,314,000	5,000	*04*	—	—
Oats	1.867.000	2,038,000	—	—	171,000	*8·4*
Mixed Corn	124.400	134,500	—	—	10,100	*7·5*
Rye	50.300	58,600	—	—	8,300	*14·2*
Beans	190 800	241,700	—	—	50,900	*21.1*
Peas	131.000	171,200	—	—	40,200	*23·5*
Potatoes	493.200	452,200	41,000	*9·1*	—	—
Turnips and Swedes	806 400	832,500	—	—	26,100	*3·1*
Mangold	359.000	389,700	—	—	30,700	*7·9*
Cabbage, Savoys and Kale	73.000	80,200	—	—	7,200	*9·0*
Kohl-rabi	10.800	14,500	—	—	3,700	*25·5*
Rape	66 000	68,300	—	—	2,300	*3·4*
Vetches or Tares	88.400	112,300	—	—	23,900	*21.3*
Lucerne	54.000	64,600	—	—	10,600	*16·4*
Mustard for Seed	22.900	36,200	—	—	13,300	*36·7*
Brussels Sprouts	20.700	20,500	200	*1·0*	—	—
Cauliflower or Broccoli	11.700	12,400	—	—	700	*5 6*
Carrots	8.200	10,700	—	—	2,500	*23·4*
Onions	2.200	2,600	—	—	400	*15·4*
Celery	4.800	5,900	—	—	1,100	*18·6*
Rhubarb	6.200	6,300	—	—	100	*1·6*
Sugar Beet	54.700	22,400	32,300	*144·2*	—	—
Linseed	3.700	5,200	—	—	1,500	*28·8*
Hops	26.200	25,900	300	*1·2*	—	—
Small Fruit	68.400	73,500	—	—	5.100	*6·9*
Orchards	238 000	239,500	—	—	1,500	*0·6*
CLOVER and ROTATION GRASSES — For Hay ..	1.722.000	1,752,000	—	—	30,000	*1·7*
CLOVER and ROTATION GRASSES — Not for Hay	852.000	796,000	5 6,000	*7·0*	—	—
CLOVER and ROTATION GRASSES — TOTAL ..	2.574.000	2,548,000	26,000	*1·0*	—	—
BARE FALLOW	462 800	355,600	107,200	*30·1*	—	—

* Mountain Heath, Moor, Down and other rough land used for grazing.

The total area returned as under crops and permanent grass in England and Wales this year is 25,755,000 acres, or 122,000 acres less than in 1924. The area returned as rough grazings is 5,028,000 acres, an increase of 82,000 acres, so that the total area of land coming within the scope of the returns is 40,000 acres less than last year.

The area of arable land is 10,680,000 acres, a decline of 249,000 acres as compared with last year. This year's area is 318,000 acres, or about 3 per cent., less than in 1914. Practically every county shares in this year's decline.

Cereals.—In spite of unfavourable weather for sowing last autumn the acreage under wheat is only 46,000 acres less than ln 1924. The

total of 1,499,000 acres is, however, the lowest since 1904. Some counties, including Norfolk, Lincoln and the Isle of Ely, have larger acreages than last year. On the other hand, reductions exceeding 10 per cent. are recorded in Bedford, Worcester, Hereford, the North Riding and a few other counties. Essex will harvest nearly 10,000 acres less than last year. There is little change in the area of barley, and the total of 1,319,000 acres is 5,000 acres greater than last year. The north-eastern counties have increased areas, but in other districts reductions are fairly general. Considerably less land is under oats this year, only 1,867,000 acres being occupied by this crop. This represents a decrease of 171,000 acres on the year and is the lowest acreage since 1888. Every county shared in the decrease, and in every division of England except the northern and north-western the reductions are approximately 10 per cent.

Forecasts of the yields per acre of corn crops, based on the condition of the crops on 1st August, suggest that the total production of wheat, barley and oats this year will be approximately as shown in the following table. It must be borne in mind that the forecasts of the yields were made when the great bulk of the crops were still uncut and are consequently subject to revision.

	Forecast, 1925. Cwts.	Production, 1924. Cwts.
Wheat	25,715,000	27,260,000
Barley	18,525,000	20,280,000
Oats	25,076,000	29,980,000

Beans and Peas.—The acreages of both beans and peas are smaller than last year by over 20 per cent. Beans cover 190,800 acres, the smallest area ever recorded, and peas 131,000 acres, the smallest area since 1917.

Potatoes.—For two seasons potatoes have sold at high prices and this probably explains the much increased plantings this year. The acreage on agricultural holdings is 493,000 acres, or 41,000 acres more than in 1924 and 58,000 acres above the pre-war average. All the chief potato-growing counties show increases, especially those in the east of the country.

Roots.—The area returned as sown or intended to be sown with turnips or swedes is 26,000 acres less than in 1924, and the total of 806,400 acres is the smallest ever recorded. The mangold area also shows a decline as compared with last year, only 359,000 acres being under this crop, a decrease of 30,700 acres. Only one county, Lincoln (Holland), has more land under mangolds than in 1924.

Sugar beet again shows a notable increase, 54,700 acres being under this crop as compared with 22,400 acres last year. The bulk of this crop is still in the east, but west midland and some south-western counties are growing appreciable acreages this year.

Other Crops.—All the minor fodder crops are being grown on reduced acreages, especially kohl-rabi which shows a decrease of 25 per cent., vetches which are reduced by 21 per cent. and lucerne by 16 per cent. The area of mustard grown for seed, 22,900 acres, is less than two-thirds that of 1924, but is greater than in 1921 and 1922. There is practically no change in the area of hops.

Vegetables.—Brussels sprouts are the only vegetable crop returned as occupying a larger area than last year and the increase is small. Carrots which were very cheap last winter record a fall of 2,500 acres.

Onions occupy an exceptionally small acreage. Celery which had been increasing in favour for some years has received a sharp set-back.

Fruit.—The acreage of orchards is much the same as in 1924. There is some increase in the south-eastern counties and a reduction in the west. Small fruit on the other hand shows a decline. More currants and gooseberries are returned but less strawberries and raspberries.

Clover and Rotation Grasses and Meadow Hay.—There is this year a slight increase in the area of clover and rotation grasses, the total being 2,574,000 acres against 2,548,000 acres in 1924. The acreage mown, however, has declined by 30,000 acres, but most of the eastern counties show increases. Less permanent grass also has been mown this year, the acreage kept for hay being 4,312,000 acres, a reduction of 189,000 acres, decreases being general throughout the country.

Fallow.—With heavy land working very unkindly after the wet winter, it is not surprising to find a large increase in the area of bare fallow. The total acreage, 462,800 acres, is 107,000 acres greater than in 1924, but is smaller than in the three years following the war.

LIVE STOCK.

CATTLE.

	1925.	1924.	Increase.	
	No.	No.	No.	Per Cent.
Cows and Heifers in Milk	2,035,100	2,014,200	20,900	1·0
Cows in Calf, but not in Milk ...	299,600	281,500	18,100	6·4
Heifers in Calf	378,500	367,400	11,100	3·0
Other Cattle :—Two years and above	1,061,000	986,800	74,200	7·5
„ „ One year and under two	1,177,500	1,084,400	93,100	8·6
„ „ Under one year ...	1,211,600	1,160,000	51,600	4·4
Total of Cattle	6,163,300	5,894,300	269,000	4·6

The number of cattle again shows an increase, and the addition this year is greater than in any recent year. The total of 6,163,000 is 269,000 larger than in 1924 and 646,000 greater than in 1921. The average in the ten years immediately preceding the war was 5,809,000. Practically every county has more cattle than last year. Cows and heifers in milk or in calf number 2,713,000, or 50,000 more than last year, which already was a record number. Calvers show relatively a larger increase than cows in milk. Cheshire has now more dairy cattle than in 1923. Other cattle of all ages are in greater numbers than last year, and more calves are being reared than in any year since the war. The number of cattle under one year old is 1,211,600, or 46,600 more than the pre-war average.

SHEEP.

	1925.	1924.	Increase.	
	No.	No.	No.	Per Cent.
Ewes kept for Breeding	6,392,500	5,993,600	398,900	6·7
Other Sheep :—One year and above...	2,882,200	2,557,800	324,400	12·7
„ „ Under one year ...	6,699,700	6,291,800	407,900	6·5
Total of Sheep	15,974,400	14,843,200	1,131,200	7·6

For the third year in succession the flocks of the country have been increased, and the total number of sheep and lambs, 15,974,000, is 1,131,000 greater than in 1924. The flocks are now within measurable distance of the pre-war numbers; a further increase similar to that of this year would restore the flocks practically to the 1914 level. Increases in the flocks were general throughout the country. The number of breeding ewes is 6,392,000, an increase of practically 400,000, the total being now only 300,000 less than in 1913. The number of sheep, other than breeding ewes, above one year old is about 12½ per cent. greater than in 1924, and there are increased numbers in practically every county.

PIGS.

	1925.	1924.	Decrease.	
	No.	o.	No.	Per Cent.
Sows kept for Breeding	316,300	449,000	132,700	29·6
Other Pigs	2,326,700	2,779,300	452,600	16·3
Total of Pigs	2,643,000	3,228,300	585,300	18·1

The exceptionally large number of pigs recorded last year has not been maintained, but in spite of the reduction of 585,000, or 18 per cent., the number is still large as compared with previous years. The total number returned as on agricultural holdings is 2,643,000, or 379,000 more than the average of the ten years 1915-24. Breeding sows show a relatively sharper reduction than other pigs, and the total of 316,300 is only 2,000 above the ten years' average. Every county has fewer sows than last year, but Cheshire shows an increase in its total of pigs.

HORSES.

		1925.	1924.	Decrease.	
		No.	No.	No.	Per Cent.
Horses used for Agricultural purposes (including Mares for Breeding).		773,100	782,500	9,400	1·2
Unbroken Horses (including Stallions)	One year & above	149,100	181,400	32,300	17·8
	Under one year	44,800	54,800	10,000	18·2
Other Horses		197,100	213,500	16,400	7·7
Total of Horses		1,164,100	1,232,200	68,100	5·5

The number of horses on agricultural holdings shows a further decline this year. The reduction is mainly in unbroken horses, and horses not used for agricultural purposes. Horses used for agricultural purposes number 773,000, or 9,400 less than in 1924, but only 18,000 less than in 1914. Unbroken horses above one year old number 149,000, or 32,000 less than last year. The number of foals bred this season again shows a very sharp decline and the total is little more than 40 per cent. of the number of 1914. The amount of horse-breeding now taking place seems quite insufficient to maintain the working horses on farms on their present level.

ACREAGE OF HOPS.

PRELIMINARY STATEMENT compiled from the Returns collected on the 4th June, 1925, showing the ACREAGE under HOPS in each COUNTY of ENGLAND in which Hops were grown, with a COMPARATIVE STATEMENT for the Years 1924 and 1923.

COUNTIES, &C.		1925.	1924.	1923.
		Acres.	Acres.	Acres.
KENT	East	3,690	3,660	3,540
	Mid	5,420	5,410	5,200
	Weald	7,150	6,900	6,720
	Total, Kent ...	16,260	15,970	15,460
HANTS		1,040	1,040	1,020
HEREFORD		4,150	4,100	3,890
SURREY		180	220	210
SUSSEX		2,420	2,390	2,260
WORCESTER		2,060	2,080	1,950
OTHER COUNTIES		110	100	100
Total		26 220	25,900	24,890

* * * * * *

Foot-and-Mouth Disease.—*Yorkshire* (East Riding) outbreak.—No further cases of the disease followed that confirmed at Ottingham on 3rd July, and the restrictions imposed on the movement of animals in East Yorkshire were consequently withdrawn on 1st August.

Hampshire.—Two cases of foot-and-mouth disease occurred at Fawley, near Southampton, on 1st August. The infected animals, and those in contact with them—totalling 54 cattle, 37 pigs and 177 sheep—were slaughtered, and restrictions were imposed immediately on the movement of animals within a radius of about 15 miles from Fawley.

* * * * * *

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Agriculture, General and Miscellaneous.

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Vol. I.—The Farm : Its Nature and Treatment. (207 pp.) 17s. 6d. net.
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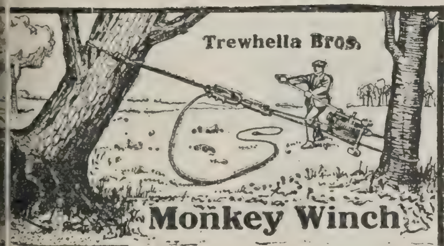

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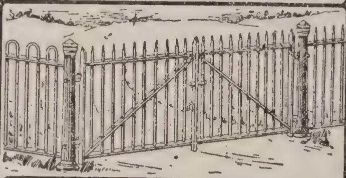

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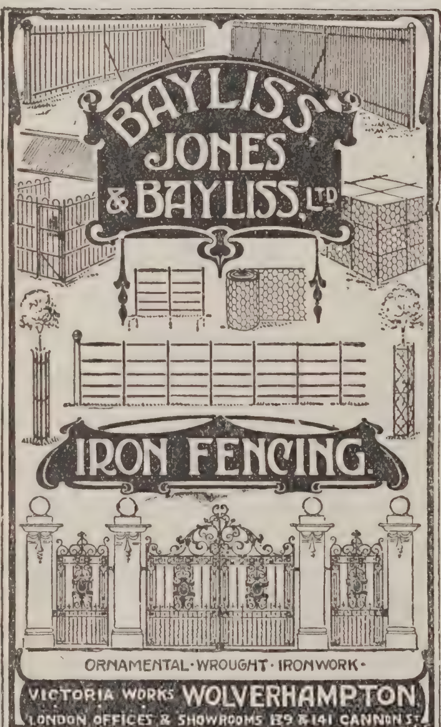

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